EXCELLENCE IN ENGINEERING AND THE NATURAL SCIENCES MADE IN GERMANY

TU9 is the alliance of leading Institutes of Technology in Germany

RWTH Aachen University
Technische Universität Berlin
Technische Universität Braunschweig
Technische Universität Darmstadt
Technische Universität Dresden
Leibniz Universität Hannover
Karlsruhe Institute of Technology
Technische Universität München
University of Stuttgart

www.tu9.de
TU9 – the alliance of leading Institutes of Technology in Germany
CONTENTS

5 . . .  Foreword

6 . . .  1.  ABOUT TU9

7 . . .  2.  THE TU9 INITIATIVE FOR MORE STEM STUDENTS
7 . . .  Joint International Student Marketing
8 . . .  Project German Schools Abroad
9 . . .  SelfAssessment international – Online Test

10 . . .  3.  ABOUT THE TU9 UNIVERSITIES
10 . . .  RWTH Aachen University – Thinking the Future
12 . . .  TU Berlin – the Technical University in the Capital of Germany
14 . . .  TU Braunschweig – the University in the Research Region
16 . . .  TU Darmstadt – Open-minded and Energetic
18 . . .  TU Dresden – Knowledge Builds Bridges
20 . . .  Leibniz Universität Hannover – Shaping the Future with Knowledge
22 . . .  Karlsruhe Institute of Technology – Unique in German Research
24 . . .  TU München – the Entrepreneurial University
26 . . .  University of Stuttgart – World-class Research University

28 . . .  4.  STUDYING IN GERMANY AND AT TU9 UNIVERSITIES
29 . . .  RWTH Aachen University – Automotive Engineering
30 . . .  TU Berlin – Global Production Engineering
31 . . .  TU Braunschweig – Mechanical Engineering
32 . . .  TU Darmstadt – Energy Science and Engineering
33 . . .  TU Dresden – Molecular Bioengineering
34 . . .  Leibniz Universität Hannover – Electrical Engineering
35 . . .  Karlsruhe Institute of Technology – Mechanical Engineering
36 . . .  TU München – Biomedical Computing
37 . . .  University of Stuttgart – Automotive and Engine Technology

38 . . .  5.  TOP-LEVEL RESEARCH AT TU9 UNIVERSITIES
38 . . .  Excellent Research for Sustainable Use of Energy
42 . . .  Excellent Research for the Mobility of the Future
46 . . .  Graduate Schools at the TU9 Universities
55 . . .  Clusters of Excellence at the TU9 Universities

Note:
For reasons of legibility, the following texts may refrain from using the feminine form. The masculine form specifically includes the female gender.
Unless otherwise stated, university statistics on the numbers of students etc. always refer to the winter semester 2013/14.
MEMBERS OF THE TU9 ALLIANCE

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Rector RWTH Aachen University

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President TU Berlin

Prof. Dr. -Ing. Dr. h. c. Jürgen Hesselbach
President TU Braunschweig

Prof. Dr. Dr. h. c. Hans Jürgen Prömel
TU9 President
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Prof. Dr. -Ing. habil. Dring/Auckland Dr.h.c./Brno
Hans-Müller Steinhegen
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Prof. Dr.-Ing. Wolfram Ressel
TU9 Vice-President
Rector University of Stuttgart
Technical universities are powerhouses of the economy and strengthen Germany’s position

Nine leading Institutes of Technology have come together under one umbrella. Why? Together we are better able to cater for the needs of the engineering sciences than individually. As an alliance we also cooperate with international networks. And with united force we build bridges to Germany for international students of STEM subjects. The TU9 Universities contribute significantly to strengthening Germany’s position as a high-tech location. We educate young scientists in STEM subjects, thus helping to counter skills shortages. We conduct research into the major issues of climate, energy, and efficient and sustainable mobility. Improving safety in the face of natural and environmental catastrophes is also on our agenda. In the areas of information and communication we investigate the needs of citizens and the economy in a globalised world. The TU9 Universities thus reflect the Federal Government’s high-tech strategy: successful research and teaching in these fields can improve the quality of life of many people worldwide. At the same time TU9 also ensures economic prosperity, or in other words jobs and wealth, in Germany. At our universities we lay the foundations for innovation. That makes us powerhouses of the economy and a significant factor in the international competitiveness of German industry. Germany is a land of engineers. TU9 is committed to it remaining so.

Prof. Dr. Hans Jürgen Prömel
President of TU9 German Institutes of Technology e. V.
1. ABOUT TU9

The TU9 Alliance

An Authority in Education
In engineering alone there were more than 130,000 students registered at TU9 Universities in the winter semester 2012/13. In addition there were some 30,000 students of natural science and almost 30,000 students of mathematics and IT. In total then, there are some 190,000 young people being educated in the so-called STEM subjects – science, technology, engineering and mathematics. Despite these positive numbers there is a bitter pill to swallow: so far it has not been possible to attract enough women to study technical subjects in Germany. Potential talents are being wasted on a large scale. Only a fifth of students of engineering at TU9 Universities are women, just over the average of all universities. A broad range of projects – from Techno Club, (where year-ten girls spend a day at university) and mentoring programmes to career planning – aim to inspire young women to study technical subjects. Here, at least, there are the first signs of success.

Leading in Research
According to the Centre for Higher Education (CHE), the research strengths of the TU9 Universities lie – not surprisingly – in the engineering sciences: electrical engineering and information technology, mechanical engineering, civil engineering, metallurgy and materials science, and computer science. In the natural sciences, and above all in physics and chemistry, the TU9 Universities achieve equally outstanding results. And they are also first class in at least one of the humanities: mathematics!

At the same time, the humanities and social sciences are essential as valuable and complementary disciplines to the identity of a TU9 University. In order to work effectively, engineers and scientists must look beyond the borders of their subjects.

Further evidence of TU9’s research strength is provided by the most prestigious supporter of research in the country, the German Research Foundation (DFG): on 31.3.2014 the TU9 members had a total of 24 collaborative research centres (SFBs) in science and engineering. This corresponds to over half of all SFBs in these fields.

TU9’s share in the DFG funding volume in engineering from 2008 to 2010 amounted to € 675 million, or 53 per cent of the total volume. N.B. we are talking about only nine universities here. In the case of the most prestigious German research prize, the Leibniz Prize of the DFG, as many as 13 out of 30 award winners between 1986 and 2010 came from TU9 Universities. A note on the side: a current president of one of the TU9 Universities also is a Leibniz prizewinner.

Judged Excellent
TU9 Universities were extremely successful in the Excellence Initiative of the Federal Government: In all funding rounds a total of nine graduate schools and 12 clusters of excellence were approved. Several TU9 Universities were successful in all three funding lines and were awarded the title “University of Excellence”: RWTH Aachen (2012, 2007), TU Dresden (2012), Karlsruhe Institute of Technology (2006, then called Universität Karlsruhe [TH]) and TU München (2012, 2006).

Internationally Attractive
People from all over the world meet on the TU9 campuses: international scientists are more likely to choose a stay at a TU9 University. 48 per cent of those awarded an engineering scholarship by the prestigious Alexander von Humboldt Foundation chose to visit a TU9 University. 54 per cent of engineering scientists funded by the DAAD did likewise. The proportion of international students at TU9 Universities is also above average, at 15 per cent. In places it is as much as one fifth of the student population. In comparison: at German universities the proportion of international students is on average eleven per cent.

Responsible for Quality
Responsibility grows from their size and history: responsibility for the students, responsibility for Germany’s research position. This is also acknowledged in the higher-education policies of the TU9 Universities.

TU9 is for example committed to retaining the tried and trusted paths to a “Doktor-Ingenieur”. In Germany, doctoral candidates in engineering and science usually earn their doctorate while gaining first work experience as a scientific assistant. The soft skills they acquire here enable doctors of engineering to enter into managerial positions and rise rapidly on the career ladder. A study carried out by 4ING and supported by TU9 shows that German doctors of engineering are highly satisfied with this kind of doctorate.

The TU9 Alliance sees itself as an advocate for quality in the engineering sciences. Its teachers, researchers and students set high standards for themselves and their own achievements. These standards are a yardstick of their work. And it goes without saying that this yardstick is also valid for their universities – the TU9.
2. THE TU9 INITIATIVE FOR MORE STEM STUDENTS

Under the terms of its statutes, TU9 supports young scientists and students, especially through joint national and international projects providing information on studying engineering or natural science in Germany. To this end, the TU9 Universities have created a joint initiative for more STEM students. The aim is to encourage international students to study a STEM subject in Germany.

**Joint International Student Marketing**

“Excellence in Engineering and the Sciences Made in Germany”: the TU9 Universities have used this motto since 2006 to attract the best students worldwide, from Beijing to Buenos Aires. In this way, the TU9 Universities gain powerful synergy effects on the international education market: as the coordination of exhibitions rotates among the TU9 Universities and the stand personnel supplies immediate information on all the TU9 Universities, a high international presence is created with efficient use of resources. Thus in 2013 we were able to advise a total of 145,000 visitors at 28 exhibition stands.

Target regions for student marketing, in addition to Eastern Europe, are especially Latin America and Asia, where there is particularly major interest in studying in Germany: at China Education Expo 2013, in Beijing alone 20,000 potential students visited the German pavilion.
Project German Schools Abroad

Cooperation Partner German Schools Abroad
Graduates of German schools abroad not only speak fluent German and have a high affinity to Germany. In most cases they also have a good to excellent knowledge of natural science and mathematics. In addition, there is a considerable interest in studying STEM subjects. The German schools abroad are therefore important cooperation partners for TU9: currently, TU9 maintains cooperation agreements with 85 German schools abroad and 11 schools with intensive German language instruction.

The aim of the cooperation is to attract students from German schools abroad to study a STEM subject in Germany. We advise not only students but also study advisors and parents on studying STEM subjects in Germany – both in person and virtually via E-counselling, an online tool developed specifically for German schools abroad. Of course we also support teachers and pupils when they visit a TU9 University, where they can have hands-on experience of university life.

TU9 DANA: German Schools Abroad – Network for School-leavers
A primary concern is to make the entry into TU9 Universities easier for graduates of German schools abroad. To this end, the school-leavers network TU9 DANA (Deutsche Auslandsschulen – Netzwerk für Absolventen) was set up in 2008. This network aims to provide excellent assistance to graduates of German schools abroad during and in particular before the start of their studies and to introduce them to each other. The 140 TU9 DANA members are important multipliers for studying STEM subjects in Germany.

The members of TU9 DANA can be contacted by students at German schools abroad before they embark on their studies. As ambassadors for TU9 they also visit their old schools. TU9 DANA university groups have been founded at several TU9 Universities; their members support each other with any problems that might arise during their studies, and also organise joint leisure activities.

For further information on TU9 DANA please visit our website www.tu9.de/dana
or contact us via auslandschulen@tu9.de

TU9-ING-Woche: a trial study week for students from German schools abroad
Since 2011, TU9 has run a TU9-ING-Woche (TU9 Engineering Week) for students from German schools abroad who are gifted in STEM subjects. 20 young people are selected to take part in this trial study week, with the opportunity to gain exclusive insights into living and studying at TU9 Universities. The trial study week is part of the DAAD BIDS programme and is funded by the Foreign Office. For one week, participants familiarise themselves with the TU9 Universities and their wide variety of study programmes in science, technology, engineering and mathematics. They play an active role in workshops and put their knowledge of STEM subjects into practice. Networking events with members of student associations provide the first contacts to TU9 students. A visit to a local company is also on the agenda of the trial study week. In this way, participants learn about a variety of career opportunities for graduates in science and engineering.

The aim of the TU9-ING-Woche is to encourage students from German schools abroad to study STEM subjects in Germany. The project is successful: So far, over half of the participants in the TU9-ING-Woche are now studying at a TU9 University. For further information about TU9-ING-Woche, visit our website: www.tu9.de/studium/tu9ingwoche.php
SelfAssessment international – Online Test

SelfAssessment international is an online service for international applicants interested in studying a STEM subject in Germany. As one element of course guidance, it helps young people in their home countries in deciding whether to study in Germany.

SelfAssessment is a tool to assist prospective international students in judging what is required to study a technical subject and to test their own strengths and weaknesses.

They work online on a range of tasks to assess mathematical skills and the ability to think logically. There is also a short German test, enabling them to make a rough estimate of their language ability.

The SelfAssessment test can be taken in either German or English and takes about 90 to 120 minutes. Students then receive detailed feedback on their strengths and weaknesses. Although SelfAssessment is neither intended nor able to replace full-scale course guidance, it can be a useful tool in conjunction with other information and guidance services when choosing a course.

SelfAssessment international was developed at the Institute for Psychology at RWTH Aachen University with the support of the DAAD. Since the launch of the platform in 2006, more than 29,000 participants have taken the test. Over two thirds of those taking the SelfAssessment test would recommend it to others. More than 45 per cent found that SelfAssessment international was a useful tool in choosing a course.

Find out whether studying a technical subject is the right thing for you: www.self-assessment.tu9.de

The statistics are based on case study N=773.

![SelfAssessment test](image)
3. ABOUT THE TU9 UNIVERSITIES

RWTH Aachen University: Thinking the Future

The Excellence Initiative of the German federal and state governments gave a strong boost to the targeted development of RWTH Aachen University. By implementing its new institutional strategy, RWTH Aachen was able to strengthen all areas of the University and enhance their profiles. In the process it has gained great momentum, which can be seen, among other things, in the extensive building activities currently underway. Visible evidence of this is the RWTH Aachen Campus that is being developed in close cooperation with business and industry and which is to form one of the largest research campuses in Europe. Students and employees of RWTH Aachen will benefit equally from these developments and are expressly invited to get involved in shaping the individual initiatives.

RWTH Graduates in High Demand

With its 260 institutes in nine faculties, RWTH Aachen is among the leading European educational and research institutions. 40,375 students in 134 courses of study are registered for the winter semester of 2013/14, including 6,395 international students from more than 120 countries. Teaching at RWTH Aachen is first and foremost application-oriented. Its graduates are therefore sought-after as junior executives and leaders in business and industry. Many board members of German corporate groups studied at RWTH Aachen.

Research Centres, Collaborations and Patents

The work of the research centres of RWTH Aachen is closely oriented towards the current needs of business and industry. This leads to numerous developments and inventions that are patented and exploited. The competence centres of RWTH Aachen achieve very effective cross-subject, inter-faculty collaboration in interdisciplinary networks such as JARA, the Jülich Aachen Research Alliance between RWTH Aachen and Forschungszentrum Jülich. The University’s innovative capacity is further reflected in the high number of business start-ups, currently more than 1,400. As a result, around 32,000 jobs have been created in the region in the last 25 years. Furthermore, RWTH Aachen is the largest employer and education provider in the region.

The Vision

RWTH Aachen aims to be an internationally recognised university with lasting excellence in research and teaching that trains outstanding academics and well-qualified young leaders for industry and society. All members of the University, including the students, pledge to support a joint high-performance culture.
Aachen: A City with a History and a City with a Future

With a population of 250,000 inhabitants, Aachen is Germany’s western-most major city. It is located at the crossroads of three countries: Belgium, Germany, and the Netherlands. The city centre has been shaped by Charlemagne and his palatine chapel – Aachen Cathedral was added to the UNESCO World Heritage List in 1978. Over 50,000 students are enrolled in one of the four educational and research institutions in Aachen. The universities and their teaching and research activities significantly contribute to future-oriented developments in science and society.

**Faculties**

- Faculty of Mathematics, Computer Science and Natural Sciences
- Faculty of Architecture
- Faculty of Civil Engineering
- Faculty of Mechanical Engineering
- Faculty of Georesources and Materials Engineering
- Faculty of Electrical Engineering and Information Technology
- Faculty of Arts and Humanities
- School of Business and Economics
- Faculty of Medicine

**Portrait of the City**

- Founded in: 1870
- Number of Students: 40,375
- Percentage of International Students: 16%
- Number of Professors: 514
- Number of Degree Courses: 134

**www.rwth-aachen.de**

*Model of a glass lung*

*Aachen Cathedral at night*
TU Berlin – the Technical University in the Capital of Germany

Portrait of the University
The university was re-founded in April 1946, and its roots go back to the Building Academy established in the 18th century. Nowadays, TU Berlin is an internationally famous university in the German capital, at the heart of Europe. With about 31,000 students in 115 degree programmes it is one of the largest institutes of technology in Germany. The main focus in research and teaching at TU Berlin is on engineering and natural sciences. In addition, it offers degree programmes in planning, social sciences, the humanities, and economics and management. Apart from the main campus, there are further sites in Berlin and a satellite campus in El Gouna, Egypt.

Research
Fundamental research in the natural science disciplines of chemistry, physics and mathematics, and strongly innovative applied research, for instance in electrical engineering and computer science, form the scientific backbone of the university. TU Berlin can boast outstanding results in all these disciplines, which are supported by the federal and state Excellence Initiative, the German Research Council, the European Union, industry and the public sector, and whose teams are global leaders in research. Research at TU Berlin is moreover characterised by close cooperation with external research institutions and industry. Well-known companies such as Deutsche Telekom AG with the Deutsche Telekom Innovation Laboratories and Siemens AG with the Center of Knowledge Interchange are actively engaged at TU Berlin.

International Matters
TU Berlin currently offers 26 dual-degree programmes with partner universities in Britain, France, Poland, China, Russia, and Chile, and 17 master’s degree programmes held in English. Some 20 per cent of students come from abroad — from more than 130 countries. In the Alexander von Humboldt Ranking TU Berlin holds second place among the technical universities. Other figures also illustrate TU Berlin’s international nature: TU Professors had 1,500 international cooperation projects between 2009 and 2011. In 2012 there were some 120 international scientific contracts at the central university level.
Founded in: 1946
(The university’s roots go back to the Building Academy established in the 18th century.)

Number of Students: 31,427

Percentage of International Students: 18.5%

Number of Professors: 335

Number of Degree Courses: 115

Faculties

- Humanities
- Mathematics and Natural Sciences
- Process Sciences
- Electrical Engineering and Computer Science
- Transport and Mechanical Systems
- Planning – Building – Environment
- Economics and Management

Portrait of the City

Berlin: Vibrant Capital
As the capital and also the largest city in Germany with a population of 3.4 million, Berlin is an attractive economic centre with a wide range of political institutions, German and international organisations, business enterprises and media centres. Numerous theatres, museums, and three opera houses offer a wide choice of cultural activities. With more than 6,000 restaurants, and woods, parks and lakes making up 40% of the city, the 132,000 students in Berlin enjoy pleasant surroundings for leisure and relaxation. Berlin has indeed become an exciting metropolis for people from all over the world.
TU Braunschweig – University in the Research Region

Portrait of the University
The history of Technische Universität Carolo-Wilhelmina zu Braunschweig began in 1745 with the foundation of the Collegium Carolinum. Nowadays, TU Braunschweig provides its students with outstanding conditions for forward-looking research and teaching in 124 institutes and departments. The academic core disciplines of engineering and natural sciences are closely linked to economics, social sciences, the humanities and education. Students benefit from the proximity of first-rate external research institutions in the region and from a wide range of cooperation agreements with industry. These provide the chance to participate in current research projects through seminar papers, dissertations and doctoral theses.

Research
Research at TU Braunschweig is based on three strategic fields of research:

- Mobility
- Infection and Active Agents
- City of the Future

Interdisciplinary research centres and competence networks in the fields of automotive engineering, aerospace technology, systems biology, pharmaceutical process engineering, and nanometrology foster thinking and working in networks and projects. Each of these fields has close ties to at least one external research institution and to research-committed companies in the region. This enables students and (young) scientists to pursue focused research and opens up exciting fields of activity.

Within the Niedersächsische Technische Hochschule (Niedersachsen Institutes of Technology, NTH), the core research areas of the three member universities TU Braunschweig, TU Clausthal and Leibniz Universität Hannover are clearly positioned and set up to complement each other.

International Matters
TU Braunschweig cooperates with universities mainly in the EU, USA, Canada, South America, China, Russia and Japan. Through the ERASMUS programme we have cooperation agreements with more than 200 universities in Europe. A third of our students spend part of their studies abroad: dual degrees with American, French, Brazilian and Russian universities open up the international career market to our graduates.

International students are an important part of our academic community. Our campus is where people from all over the world meet: we currently have students from over 100 different countries studying and doing research at TU Braunschweig. Excellent support from the International Office, the City of Braunschweig and the mentoring programme help international students to feel at home here. It goes without saying that our research is also international. Many scientists from other countries are involved in teaching and research at TU Braunschweig.
Portrait of the City

Braunschweig – “Europe’s Hottest Research Region”

Braunschweig is “Europe’s hottest research region” according to European Union statistics. No other region has a higher concentration of people working in research and development. The internationally famous research institutions alone employ more than 15,000 people. With a population of more than 250,000, Braunschweig has all the advantages of a city, and yet everything can be easily reached by bicycle – also from the campus. Half-timbered houses, attractive shops and pubs create a special atmosphere in the city centre and the historic Magni Quarter. The River Oker, which turns the centre into an island, and the many parks invite you to relax right in the centre of the city.

Faculties

Carl-Friedrich-Gauß Faculty (mathematics, computer science, economics and business administration, social sciences)

Life Sciences

Architecture, Civil Engineering and Environmental Sciences

Mechanical Engineering

Electrical Engineering, Information Technology, Physics

Humanities and Education
TU Darmstadt – Open-minded and Energetic

Technische Universität Darmstadt
Since its foundation in 1877, TU Darmstadt has played its part in addressing the urgent issues of the future with outstanding research and teaching. TU Darmstadt focuses on selected problem areas which are represented in the university’s research profile: Thermo-fluids and combustion engineering, new materials, matter and radiation science, integrated product and production technology, and the future internet. Technology is at the heart of all our disciplines at TU Darmstadt. The natural sciences as well as social sciences and humanities cooperate closely with engineering.

Our students learn to combine excellent research and practical applicability from the very beginning. Our scientists conduct seminal basic research and creatively transfer their insights into technological solutions. The technology they create fits smartly into complex operating environments.

TU Darmstadt is a well-respected and internationally recognised university by tradition. As one of the universities in Germany with the highest number of foreign students TU Darmstadt follows its ambitious internationalisation strategy in order to enhance the international and intercultural qualification of the students and attract international master’s students and foreign scientists.

In renowned rankings by the German Research Foundation (DFG), the Alexander von Humboldt foundation, and the Centrum für Hochschulentwicklung (CHE), as well as polls of the personnel directors of major corporations, its leadership in research, academic excellence, and its qualification of graduates for top jobs and successful careers has been consistently corroborated.
Darmstadt - City of Science
With almost 150,000 inhabitants, Darmstadt lives up to its reputation as the 'City of Science': The Technische Universität Darmstadt and around 30 other international institutions like the ESOC, the ‘Gesellschaft für Schwerionenforschung’ (GSI), three Fraunhofer Institutes and research-oriented enterprises like Merck, Deutsche Telekom and Software AG contribute to the prosperity and progress of the Rhine-Main-Neckar Region. Moreover, the city is proud of the Mathildenhöhe, Darmstadt’s major Art Nouveau centre, its theatre and its cultural life in general.

**Portrait of the City**

- **Founded in:** 1877
- **Number of Students:** 25,100
- **Percentage of International Students:** 18%
- **Number of Professors:** 300
- **Number of Degree Courses:** 110

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**Departments**

- Law and Economics
- History and Social Sciences
- Human Sciences
- Mathematics
- Physics
- Chemistry
- Biology
- Materials and Earth Sciences
- Civil and Environmental Engineering
- Architecture
- Mechanical Engineering
- Electrical Engineering and Information Technology
- Computer Science

**Fields of Study**

- Computational Engineering
- Energy Science and Engineering
- Information Systems Engineering
- Mechanics
- Mechatronics

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**Faculties**

- www.tu-darmstadt.de
Technische Universität Dresden – Knowledge Builds Bridges

Technische Universität Dresden is one of the top universities in Germany and in Europe: strongly committed to research, first-rate in terms of the diversity and quality of its degree courses, and closely linked to culture, business and society. As a full-scale modern university with 14 faculties, it offers a broad and multi-faceted scientific spectrum that only few other universities in Germany are able to match. It is not merely the range of specialised subject areas but also the focus on networking and interdisciplinarity in both teaching and research that forms the basis of TU Dresden’s achievement potential.

In 2012, TU Dresden was identified as one of the eleven Universities of Excellence in Germany, confirming its reputation as one of the premier institutions for study and research in Germany. In addition, TU Dresden boasts two Clusters of Excellence – the “Center for Advancing Electronics Dresden” (cfaed) and the “Center for Regenerative Therapies Dresden” (CRTD) – as well as the “Dresden International Graduate School for Biomedicine and Biotechnology” (DIGS-BB).

TU Dresden’s campus family comprises 37,000 students and approximately 7,900 employees, including more than 500 professors. Here young people and scientists from over 120 countries are engaged in studies and research activities. More than 4,400 of the students are from abroad.

The success of TU Dresden is based mainly on its collaboration with non-university-affiliated research establishments and cultural institutions within the research alliance DRESDEN–concept (Dresden Research and Education Synergies for the Development of Excellence and Novelty). This alliance aims to further showcase on an international level the excellence of research undertaken in Dresden. The partners develop and use synergies in research, education, infrastructure and administration. They coordinate their scientific strategies and identify the areas where Dresden is an international leader. They develop a joint strategy to bring leading scientists from all over the world to Dresden. This highly dynamic environment is attractive: From all over the world, young people embarking on their studies as well as prominent scientists value TU Dresden as a place for studying, researching and teaching.

TU Dresden dates back to the Technische Bildungsanstalt Dresden, founded in 1828, and is thus one of the oldest technical and academic educational institutions in Germany.
Founded in: 1828
Number of Students: 37,000
Percentage of International Students: 11.8%
Number of Professors: 500
Number of Degree Courses: 124

Portrait of the City

Dresden invites you to stroll through its impressive history, to experience the present and to help shape the future. The capital of Saxony is one of the most beautiful cities in Europe, boasting an impressive ensemble of historic buildings, art treasures galore and a varied programme of cultural events. This vibrant metropolis attracts not only tourists but also leading academics, dynamic entrepreneurs and outstanding students from around the world who want to be part of the unique ‘Dresden Spirit’. The innovative genius of Dresden extends far back into history. It is here that the first European white porcelain was invented, and later, the single-lens reflex (SLR) camera was to confirm Dresden’s reputation as a centre of creative excellence. Today, every second chip manufactured in Europe comes from Dresden, while acclaimed academics are engaged in pioneering research into that miracle of regeneration, the axolotl, and developing new materials that will shape our lives in the future.

Faculties

More autonomy, synergies, interdisciplinarity, strategic and operative scope: Guided by this vision TUD’s Faculties are reorganising into 5 Schools.

School of Science
- Faculty of Science, comprising the Departments of Biology, Chemistry, Mathematics, Physics and Psychology

School of Humanities and Social Sciences
- Faculty of Education
- Faculty of Law
- Faculty of Arts, Humanities and Social Science
- Faculty of Linguistics, Literature and Cultural Studies
- Faculty of Business and Economics

School of Engineering Sciences
- Faculty of Electrical and Computer Engineering
- Faculty of Computer Science
- Faculty of Mechanical Science and Engineering

School of Civil and Environmental Engineering
- Faculty of Architecture
- Faculty of Civil Engineering
- Faculty of Environmental Sciences
- Faculty of Transportation and Traffic Science

School of Medicine
- Faculty of Medicine Carl Gustav Carus
Leibniz Universität Hannover – Shaping the Future with Knowledge

Portrait of the University
With just under 24,000 students, Leibniz Universität Hannover is the second largest university in Lower Saxony. There are approx. 180 full-time and part-time degree programmes in engineering and natural science, law, economics and management, the humanities and social sciences. More than 300 professors, 2,400 other academic staff, and 1,700 technical and administrative staff ensure that research and teaching at Leibniz Universität Hannover will maintain its leading position in the years to come. In 2012 the university had an income of €395 million, more than €85 million of which was derived from third-party funding, including from industry.

International Matters
International contacts are part of everyday life at Leibniz Universität Hannover. The fact that twelve per cent of students come from abroad is living proof of the international attractiveness of the university. As the first port of call, the International Office organises events to welcome newcomers and finds student tutors to help international students. 1,364 exchange places at 348 universities in 54 countries also offer our students the chance to spend time abroad. Leibniz Universität has more than 140 cooperation agreements with 120 universities in 40 countries, including an important strategic partnership with St Petersburg. In addition, international degree programmes such as the Graduate College in physics and the master’s degree in International Horticulture at the Faculty of Natural Sciences are being developed further.

Research
In research, Leibniz Universität Hannover focuses on nationally and internationally competitive areas. The university plays a leading role in quantum optics and gravitation physics, in production technology with the Production Technology Centre, and in biomedical engineering and research, also as a partner in the Cluster of Excellence REBIRTH. In addition, the university gives priority to the fields of energy, plant science and nutrition, and to geo and environmental sciences, which are to be developed further in the next few years. Finally, cross-faculty Leibniz Research Centres represent interdisciplinary research.

Leibniz Research Centres:
- Hannover Centre for Optical Technologies (HOT)
- Laboratory of Nano and Quantum Engineering (LNQE)
- L3S Research Centre (research in Web Science)
- Hannover Centre of Mechatronics (MZM)
- Centre of Biomolecular Drug Research
- Centre for Solid State Chemistry and New Materials (ZfM)
- Leibniz Research Centre Energy 2050 (LiFE)
- Centre for Garden Art and Landscape Architecture (CGL)
Hannover

**Founded in:** 1831

**Number of Students:** 24,000

**Percentage of International Students:** 12%

**Number of Professors:** 324

**Number of Degree Courses:** 180

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**Portrait of the City**

*View from Lake Maschsee of the New City Hall*

**The City of Hannover**

As the state capital, Hannover is the economic centre of Lower Saxony. It is internationally famous, e.g. as the site of the world’s largest computer fair CeBIT. Culturally, Hannover has a lot to offer with the Sprengel Museum, Wilhelm-Busch-Museum, Kestner Gesellschaft, its many theatres and the opera. In addition, the jazz club, many pubs and the vibrant streets of the old quarter offer plenty of attractive ways to spend the evenings. The paths along Lake Maschsee and the Rivers Ihme and Leine are ideal places for jogging, walking, skating or just taking a stroll.

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**www.uni-hannover.de**

**Faculties**

- Faculty of Architecture and Landscape Sciences
- Faculty of Civil Engineering and Geodetic Science
- Faculty of Electrical Engineering and Computer Science
- Faculty of Law
- Faculty of Mechanical Engineering
- Faculty of Mathematics and Physics
- Faculty of Natural Sciences
- Faculty of Humanities
- Faculty of Economics and Management
- QUEST Leibniz Research School
Karlsruhe Institute of Technology – Unique in German Research

In October 2009, Karlsruhe Institute of Technology (KIT) was established by a merger of Universität Karlsruhe (TH) and Forschungszentrum Karlsruhe. KIT is an institution with a double mission – that of a university with teaching and research tasks and that of a national research centre of the Helmholtz Association conducting programme-based provident research. KIT’s three strategic fields of action are research, teaching, and innovation.

Research
The seven KIT Centers
- Elementary Particle and Astroparticle Physics
- Energy
- Information, Systems, Technologies
- Climate and Environment
- Materials, Structures, Functions
- Humans and Technology
- Mobility Systems

pool all programme-based and coordinated research activities, represent the strategic research areas of KIT to the public, and act as a communication and strategy platform for partners inside and outside of KIT.

Teaching
Teaching is organized in eleven KIT Departments: Architecture; Civil Engineering, Geo- and Environmental Sciences; Chemistry and Biosciences; Chemical and Process Engineering, Electrical Engineering and Information Technology; Humanities and Social Sciences; Informatics; Mechanical Engineering; Mathematics; Physics; Economics and Management. Because of its unique combination in Germany of the strengths of a research centre and a university, KIT promotes a research- and student-oriented teaching and learning culture, and thereby ensures optimum research-based studying conditions. During their studies students are introduced to genuine research projects in research-based and applied teaching modules. The experience they gain there can be applied in a future career in science or in industry.

Innovation
KIT is committed to shaping the cooperation of science and industry in such a way that research results are optimally transferred to the market. Its aim is to develop new products, processes or services. KIT’s innovation management covers the entire range from advising inventors and applying for patents, to marketing technology, project initiation, licensing, and the support of spinoffs, as well as business training of young scientists, and the support of start-ups established by students. To identify market trends and respond to the requirements of industry, KIT offers central cooperation platforms, such as the KIT Business Club.
Founded in: 2009
Number of Students: 24,528
Percentage of International Students: 16%
Number of Professors: 346
Number of Degree Courses: 89

Portrait of the City

Karlsruhe Palace: Where the slats of the fan that is Karlsruhe meet. KIT’s Campus South is located close-by.

Karlsruhe – Location of Science and Industry
It was here that Drais invented the bicycle in 1817 and Benz the automobile in 1885. In 1886, Hertz discovered electromagnetic waves in Karlsruhe. And nowadays? Karlsruhe is a prominent centre of education and science, closely linked to a regional industry working at the cutting edge of new developments and superbly positioned in markets of the future. The second largest city in Baden-Württemberg combines all this with a unique location on the River Rhine between Alsace and the Black Forest, southern flair and a relaxed way of life.

KIT Departments

Architecture
Civil Engineering, Geo- and Environmental Sciences
Chemistry and Biosciences
Chemical and Process Engineering
Electrical Engineering and Information Technology
Humanities and Social Sciences
Informatics
Mechanical Engineering
Mathematics
Physics
Economics and Management
TUM – the Entrepreneurial University

Technische Universität München (TUM) is one of Europe’s leading technical universities for research. Its unparalleled choice of subjects takes in engineering, the natural and life sciences, medicine, economics and education. No other university in Germany offers such a wide-ranging combination.

Interdisciplinary Solutions to Future Challenges

TUM is capitalizing on its unique advantages by promoting multidisciplinarity in research and teaching. One example is the MUTE electric car, which TUM unveiled at the International Motor Show (IAA) in 2011. The vehicle was developed by researchers and students from twenty different institutes. This is the kind of interdisciplinary collaboration that will be needed to solve the major challenges facing society. With this in mind, TUM is focusing on the following strategic areas: Energy & Climate, Mobility, Health & Nutrition, Communication & Information, Infrastructure, and Natural Resources. At the same time, it is seeking answers to pressing questions about the social aspects of new technologies.

Promoting Talent Diversity

As an entrepreneurial university, TUM is committed to supporting the diverse talents of its students and staff. Its top-class course offering has a strong research character. Meanwhile, TUM offers individual support: through the “Young Academy” programme for its most dedicated young students, with mentoring and career advice as well as exchange opportunities with over 150 partner universities and 300 Erasmus partners. The TUM Graduate School gives doctoral students the chance to obtain cross-disciplinary qualifications. And with its tenure track system, TUM is setting new standards in the German higher education sector. Under this system, young professors are rewarded with attractive career prospects if they meet high performance standards.

Fostering Entrepreneurship

Ever since the 1870s, when Carl von Linde invented his refrigeration system at TUM and founded the company that was to become Linde AG, TUM has been fostering close relationships with the major industrial concerns. The university inspires and empowers its students and researchers to think and act like entrepreneurs. It also systematically supports patent applications and start-ups.

Global University

TUM is an international university with a high proportion of foreign students and researchers. It offers more than twenty courses in English. With TUM Asia in Singapore, it became the first German university to establish an overseas campus. It also has locations in Brussels, Cairo, Mumbai, Beijing and São Paulo.

Recipient of Top Awards

TUM was awarded the title of “University of Excellence” in 2006 and 2012 on account of its drive for innovations and reform. In international rankings, it is regularly placed among the best universities in Germany.
Portrait of the City

The Alps are almost close enough to touch – city life and spectacular landscapes lie side by side in the Munich area.

Munich – a Cosmopolitan City with Flair

Munich is a city with a cosmopolitan, international outlook. In all areas of life – from business to science, culture to sport, nightlife to nature – people from all over the world are drawn to Munich’s creative, dynamic lifestyle. TUM’s main campus is located right in the middle of the city’s museum quarter. You can go straight from a conference at a major company’s HQ to the peaceful expanse of the “English Gardens”. Germany’s largest university sports community is based in the Olympic Park. From the roof terrace of TUM’s city campus, the Alps look close enough to touch. And the clear waters of the Bavarian lakes are just an hour away.

Founded in: 1868
Number of Students: 36,000
Percentage of International Students: 20%
Number of Professors: approx. 500
Number of Degree Courses: approx. 150

Faculties

Architecture
Center of Life and Food Sciences
Weihenstephan
Chemistry
Civil, Geo and Environmental Engineering
Electrical Engineering and Information Technology
Informatics
Mathematics
Mechanical Engineering
Medicine
Physics
Sport and Health Sciences
TUM School of Education
TUM School of Management

Integrative Research Centers:
Munich Center for Technology in Society
Munich School of Engineering
TUM Institute for Advanced Study

www.tum.de
University of Stuttgart – World-class Research University

The University of Stuttgart lies at the centre of one of the largest high-tech regions in Europe with global players such as Daimler and Bosch, innovative small and medium-sized enterprises, and renowned research institutions. Founded in 1829, the former Institute of Technology has developed into a research-intensive university with an orientation predominantly in the fields of engineering and natural science. Its special profile includes linking these subject areas with the humanities and social sciences.

Its outstanding position is reflected in its two projects supported by the federal and state Excellence Initiative, the Cluster of Excellence “Simulation Technology” and the Graduate School “Advanced Manufacturing Engineering“, as well as in its participation in a number of collaborative research centres and research training groups. The research activities of the University of Stuttgart focus on the following eight interdisciplinary areas: Modelling and Simulation Technologies, New Materials, Complex Systems and Communication, Technology Concepts and Technology Assessment, Sustainable Energy Supply and Environment, Mobility, Integrated Product and Production Design, and the Design and Technology of Sustainable Living Spaces. In order to expand its leading position in these fields, the University of Stuttgart wishes to further strengthen its research excellence in interdisciplinary cooperation networks, improve its international profile and concentrate on global issues in the future. Behind this is the vision of thoroughly investigating the entire creation and life cycle of products. This includes engineering and realisation as well as the evaluation of the sustainability of technical innovations.

With the Institutional Strategy ARENA2036, which brings researchers from university institutes and industry together under one research factory roof in the area of production and lightweight engineering, the University of Stuttgart has entered a new era of research partnerships. This project is part of the Cooperative Research Campus, which is also home to the research areas eHumanities (Digital Culture & Technology), Information Technology, and Energy Storage/Systems. The Cooperative Research Campus aims to exploit the close constellation – unique in Europe – of the four powers from university, external research institutions, industry and society to combine regional resources in facing the global challenges of the future.

With this focus the University of Stuttgart has become a globally sought-after institute of higher education with a comprehensive range of subjects. More than 26,000 students, including 20 percent overseas students, are registered in almost 150 institutes in ten faculties, There are some 120 undergraduate and graduate degree programmes, including twelve international master’s programmes held in English. In addition, there are double degree programmes with universities from all over the world. Every year more than 2,000 graduates enter the workforce.

The International Centre provides a “Welcoming Service” for new international students. Orientation weeks at the beginning of the semester, support with formalities, provision of tutors, organisation of events and excursions are as much a part of the service as the intensive support through language courses.
Portrait of the City

City of Stuttgart
Stuttgart, the capital of Baden-Württemberg, lies at the heart of a highly dynamic economic region that is famous all over the world, a region that has made its mark in the areas of mobility, information technology, manufacturing and production technology, and biosciences. This city with 590,000 inhabitants is one of the greenest cities in Europe. It offers a rich variety of cultural and leisure activities, from the much acclaimed State Opera and the internationally famous ballet to first class sports events and festivals, and the many museums. In the nearby Swabian Alb and the Black Forest, nature lovers will find many opportunities for walking, climbing or winter sports.

Faculties

Architecture and Urban Planning
Civil and Environmental Engineering
Chemistry
Energy Technology, Process Engineering and Biological Engineering
Computer Science, Electrical Engineering and Information Technology
Aerospace Engineering and Geodesy
Engineering Design, Production Engineering, Automotive Engineering
Mathematics and Physics
Humanities
Management, Economics and Social Sciences
4. STUDYING IN GERMANY AND AT THE TU9 UNIVERSITIES

1. Germany as a Place to Study

Of the current 2.5 million students in Germany, about 10 per cent come from abroad – at TU9 Universities this figure is 15 per cent. Many international students value the high standard of German universities and the broad spectrum of courses. In particular, the education of engineers at the technical universities enjoys an excellent reputation worldwide.

In addition, Germany offers a high quality of life to students: cities in particular benefit from cultural diversity and an international flair. In many places students can take part in cultural and leisure activities at a concessionary rate. Opportunities for students to participate in university life are many and varied: they can become involved in the Student Council or in Student Faculty Councils, participate in university sports or join an orchestra or many other student associations.

2. Degrees

The Bologna reform led to the replacement of traditional German university degrees by internationally recognised bachelor’s and master’s degrees. At the end of the undergraduate phase, which takes three or four years, students acquire a bachelor’s degree. The second phase usually leads to a master’s degree after two further years.

Courses leading to a profession under state supervision are usually completed by a state examination: this includes such subjects as law, food chemistry and medicine as well as teaching qualifications.

3. STEM Subjects at TU9 Universities

There are a wide variety of degree courses to choose from at TU9 Universities: we offer our students excellent education in more than 900 courses. The emphasis is on engineering and the natural sciences. In addition, you can also study economics and business administration, the humanities and social sciences at the TU9 Universities – as an important addition to engineering courses and as subjects in their own right.

Studying at TU9 Universities is international: students from all over the world are enrolled in more than 130 master’s degree courses held in English. Through international partnerships, students are able to study abroad or to take double degrees. The introduction of bachelor’s and master’s degrees has created excellent conditions for students to change universities across international borders.

With their sound education, graduates of TU9 Universities are much sought after – not only in Germany. A TU9 degree opens up a wide range of career opportunities in international industry and research. Many senior managers of leading German enterprises, for instance, are TU9 graduates.

This is also due to the strong practical orientation of the courses. Students acquire not only expertise in their subject but also key qualifications and language skills. Internships and stays abroad are integral parts of their studies. Students at TU9 Universities are thus optimally prepared for their later professional activity – also in an international context.

For further information about studying at TU9 Universities please visit our website:

www.tu9.de/studies
Information for prospective students

www.tu9.de/degreeprogrammes
Overview of degree programmes offered at TU9 Universities

www.tu9.de/master
Overview of master’s programmes in English at TU9

Do you have questions about studying at TU9 Universities? Please write us an e-mail: studies@tu9.de
Aim of the Programme
The aim of the programme is to increase engineering competences, especially in the fields of mobility and transport. The course modules provide or extend expertise in all of the main areas of automotive engineering such as chassis, safety, or driver assistance systems.

Study Abroad
Students may apply to take part in a double degree programme with Tsinghua University, China. Study periods abroad in Europe or other overseas destinations are also possible.

Admission Requirements
Bachelor of Science in an engineering or natural science subject, or equivalent university degree

Career Prospects
The extensive inter- and multidisciplinary training enables graduates to work independently in their future career in the automobile industry. Graduates are qualified to take up managerial positions both in the manufacturing industry and in research and development. The Master of Science degree is also an entry qualification for a doctorate in the relevant engineering sciences and is recognised worldwide.

Further Information
www.ika.rwth-aachen.de
www.maschinenbau.rwth-aachen.de

To see the complete range of more than 130 degree courses at RWTH Aachen University visit:
www.rwth-aachen.de/go/id/yev
Aim of the Programme
Global Production Engineering (GPE) is a full-time four-semester master’s programme. GPE currently offers two majors: Manufacturing and Solar Technology. The course is aimed at outstanding international graduate students seeking to improve their personal competence portfolio in the fields of production, management, engineering, and intercultural communication. The programme promotes technical competencies in the engineering disciplines, development of manufacturing processes and tools, modelling and simulation, quality control and economic evaluation as well as the ability for lifelong learning in rapidly changing knowledge domains. Rather than focusing on business administration only, GPE enables engineers to create systematic technological innovations combined with efficient and effective industrial business management.

Admission Requirements
Bachelor of Engineering or equivalent, excellent grades, knowledge of English, professional experience

Career Prospects
GPE graduates are able to take up leading positions in engineering, functioning successfully in international value-added chains. Due to the variety of topics highlighted in the course and the opportunity for students to set their own focus, graduates can work as technology managers, engineers in the project or production industry, in consultancy, and in training and research facilities.

Further Information
Students in the GPE programme may apply to take the Climate-KIC certificate. This adds extra value to selected master’s degree programmes and supplies the knowledge needed for becoming a leader in climate innovation.

There is a compulsory tuition fee of €15,500 for the complete programme. The fee covers a wide range of services and individual guidance for the students.

www.gpe.tu-berlin.de

To see the complete range of 115 degree courses at TU Berlin visit: www.tu-berlin.de/?id=7001

Students gain practical experience from group work projects.
TU Braunschweig: Mechanical Engineering

Degree programmes: Mechanical Engineering, Automobile Technology, Aerospace Engineering, Bioengineering, Mobility and Transportation, Industrial and Mechanical Engineering

Academic title: Master of Science; double-degree is possible

Standard time to degree: 4 semesters

Language: German

Aim of the Programme
The master's programmes in Mechanical Engineering provide graduates with advanced professional, methodical and personal qualifications and prepare them for independent scientific work and leading positions in a variety of research and professional fields.

Study Abroad
Exchange programmes can easily be integrated into the programme as academic recognition is guaranteed on both sides. Students have the opportunity to obtain an additional degree at an American or French university.

Admission Requirements
Candidates must hold a bachelor's degree or equivalent in the fields of engineering or natural sciences.

Career Prospects
Mechanical engineers can work in a wide range of areas depending on their degree programme and specialisation. The following areas are some options from the broad spectrum:

- Construction – e.g. of airplane structures or microchips
- Production – e.g. of vehicles or industrial robots
- Project planning and management – e.g. in research and development or in large industrial projects.
- Quality assurance – e.g. of processes and products

Further Information
www.tu-braunschweig.de/fmb

Degree programmes at TU Braunschweig with 70 courses:
www.tu-braunschweig.de/international/incomings
TU Darmstadt: Energy Science and Engineering

Academic title: Master of Science
Standard time to degree: 4 semesters
Languages: German and English

Aim of the Programme
This interdisciplinary programme offers a specialisation with a strong focus on energy. The programme accounts for both the development of renewable energy technologies and the efficient use of conventional energy sources, while considering other societal, environmental and economic aspects of energy production and consumption, and the availability of resources and aspects of climate change.

Study Abroad
A stay abroad is possible via using the exchange programmes of the eight departments participating in the study programme.

Admission requirements
Candidates must hold a bachelor’s degree in engineering or in natural science and must pass an admission test. Knowledge of English and German, both to proficiency level C1, is required.

Career Prospects
Students in the programme will gain the skills necessary to pursue careers in energy research and energy technology. Successful graduates of the programme will be technically versatile and able to independently tackle new problems in research, industry, and management.

Further Information
The master’s programme is part of the Graduate School of Excellence Energy Science and Engineering which is funded by the Excellence Initiative of the German federal and state governments.

www.esd.tu-darmstadt.de

To see the complete range of 110 degree courses at TU Darmstadt visit:
www.tu-darmstadt.de/studieren/abschluesser/abschluesser_1.de.jsp
TU Dresden: International Master’s Degree in Nanobiophysics

Academic title: Master of Science
Standard time to degree: 4 semesters
Language: English

Aim of the Programme
The master’s programme in Nanobiophysics offers an interdisciplinary education in molecular and cellular biophysics to students who have obtained a first university degree in the area of physics or technology (physics or biophysics as a rule). Graduates are able to play an active role in current research and developments of molecular cell biology and biochemistry, biophysics and nanotechnology.

Study Abroad
The course has a strong international focus and is taught in English. A semester abroad is possible, especially for writing the master’s thesis in the 4th semester. Under the Erasmus Mundus programme Nanoscience and Nanotechnology, students spend their first year of study at the KU Leuven (Belgium) and obtain a joint degree after successful graduation.

Entrance Requirements
Candidates must hold a first university degree (typically bachelor’s degree) in natural sciences (as a rule physics or biophysics) or in engineering (as a rule nanotechnology) or another university degree in a subject with comparable requirements, particularly in higher mathematics. Furthermore, proof of English proficiency is required. Students also have to provide proof of knowledge of basic classical physics like mechanics, electrodynamics, optics, thermodynamics and quantum theory as well as basic knowledge of chemistry and biology.

Career Prospects
Nanobiophysicists can work in research or teaching with the emphasis on biotechnology, nanotechnology or biomedicine or for a biotech company e.g. in the development of new pharmaceuticals. Graduates are qualified to work in R & D in the wide field of bio- and nanotechnology.

Further Information
www.biotec.tu-dresden.de/teaching/
E-Mail: anne.chesneau@biotec.tu-dresden.de

To see the complete range of 124 degree courses at TU Dresden visit: www.tu-dresden.de/studium/angebot/studienmoeglichkeiten/sins_start
Leibniz Universität Hannover:  
M.Sc. Electrical Engineering

- **Academic title:** Master of Science  
- **Standard time to degree:** 4 semesters  
- **Language:** German

**Aim of the Programme**
This degree course covers electrical engineering from the classic disciplines to modern data processing. The spectrum extends from electrical power systems, automation engineering and mechatronics via high-voltage engineering, semiconductors and microelectronics to technical informatics.

**Study Abroad**
A study period abroad is not compulsory but is recommended. Exchange programmes with universities abroad e.g. Stanford University (USA), the Universities of Bristol (England), Bordeaux (France), Valencia (Spain) or Shanghai (China) enable students to spend part of their studies abroad.

**Admission Requirements**
Bachelor of Science in engineering or natural science.

**Career Prospects**
Graduates work in research and development laboratories and in practically all branches of industry. These include energy supply companies, software firms or service industries, research institutes and education. In current key areas, such as automation engineering and vehicle electronics, mobile communication or alternative energy, numerous additional jobs are being created, providing excellent career prospects.

For further information visit:
www.uni-hannover.de/en/studium/studienfuehrer/elektro/

To see the complete range of around 180 degree courses at Leibniz Universität Hannover visit:
www.uni-hannover.de/en/studium/studienfuehrer/
Karlsruhe Institute of Technology:  
M.Sc. Mechanical Engineering

Academic title:  
Master of Science

Standard time to degree:  
4 semesters

Languages:  
German, English

Aim of the Programme
The master’s programme in mechanical engineering at the Karlsruhe Institute of Technology provides students with the opportunity to further enhance their knowledge acquired under the bachelor’s programme in the following areas of specialisation: Energy and environmental technology, vehicle technology, mechatronics and microsystems engineering, product development and construction, production technology, theoretical mechanical engineering, materials and structures for high-performance systems. The graduates of KIT’s master's programme in mechanical engineering are capable of working independently on processes to create values added in mechanical engineering and also of participating in science thanks to their research-oriented education. The graduates are qualified in particular for management positions in industry, for working in the technical service sector or in science and for working on the doctorate.

Study Abroad
Under the ERASMUS programme, students may study at 45 universities in 16 countries in and outside of Europe, including nearly all CLUSTER Universities. Moreover, KIT cooperates with the Universities of Purdue (USA) and Shanghai (China). Studying in international teams, gaining experience at development departments of German companies doing business abroad, and recognition of the examination results achieved abroad by KIT are major elements of this cooperation. Within the framework of the European consortium KIC Inno-Energy, the Department of Mechanical Engineering also coordinates the new master's programme “Energy Technologies” (ENTECH). Students profit from the network established by universities, business schools, and companies working in the energy sector: They spend the two years studying at two different universities.

Admission Requirements
Requirements for admission to the master’s programme in mechanical engineering:
- Bachelor’s degree or equivalent from a university, university of applied sciences or university of cooperative education (Berufskademie) in the area of validity of the Hochschulrahmengesetz (Framework Act for Higher Education) or at a foreign university, with at least 180 ECTS credit points, or alternatively a regular study period of at least three years in mechanical engineering or a related subject.
- A professional placement of at least twelve weeks (internships completed under the bachelor’s programme are taken into consideration.)

Career Prospects
The employment prospects of the graduates of the master’s programme are excellent. Industry increasingly needs highly qualified engineers with both broad and in-depth fundamental knowledge. The spectrum of potential activities extends from pure research and development, production and sales, to administration and management. The master's degree in mechanical engineering provides the skills necessary for starting careers.

Upon completion of their studies, graduates find work in such areas as:
- Production development and construction – e.g. of lightweight structures for mobility systems;
- Manufacturing – e.g. of cars or electromechanical systems;
- Project planning and management – e.g. in research and development or for large-scale industrial projects;
- Quality assurance – e.g. of process flows or manufactured products.

Further Information
www.mach.kit.edu
E-Mail: SCM@mach.kit.edu

To see the complete range of almost 90 degree courses at Karlsruhe Institute of Technology visit: www.kit.edu/studieren/studiengaenge.php
TU München:
Master’s Programme in Biomedical Computing

Academic title: Master of Science
Standard time to degree: 4 semesters
Language: English

The master’s programme in Biomedical Computing is a prime example of how interdisciplinary and international the range of degree programmes offered by TUM is. In many sectors nowadays, the natural sciences and engineering or technology and management expertise are in demand. The TUM prepares students from all parts of the globe for these professions across various disciplines.

Contents
Biomedical Computing combines computer science with medicine and biology. Computer-assisted imaging is playing an increasingly important role in medical diagnostics and therapy. The study programme provides knowledge of the various visualisation techniques, medical data management and image processing, as well as user interfaces. However, the focus is not only on the technology itself but also on understanding the related medical issues. In this way, students become familiar with problems in diagnosis and treatment in addition to typical hospital procedures. Several events are held in the hospitals of the TUM medical school. The aim: Enabling graduates to generate technical innovations with their medical knowledge.

Career Prospects
The market for specialists in the field of biomedical computing is growing. Graduates have outstanding career prospects in science, hospitals and industry, particularly at medical technology companies. There is a broad range of potential employers located in the Munich region.

Admission Requirements:
▪ Bachelor’s degree in computer science, mathematics, physics, electrical engineering or a related subject area
▪ Advanced proficiency in mathematics
▪ Knowledge of a modern programming language
▪ Very good English skills
▪ Passing the aptitude test

Further Information
www.in.tum.de/Biomedical_Computing

To see the complete range of over 150 degree programmes:
www.tum.de/en/studies/
University of Stuttgart:
Automotive and Engine Technology

Academic title: Master of Science
Standard time to degree: 4 semesters
Language: German

Aim of the Programme
The master’s degree in automotive and engine technology enables students to build on and implement the knowledge they have gained in their bachelor’s degree. Two specialisations are chosen from the fields of vehicles, combustion engines and vehicle mechatronics and 16 further specialisations from a wide selection e.g. road traffic, body construction, or electric drive systems. Lecturers from industry complement the academic curriculum and provide insights into working practice. Through focussed application of underlying principles, concepts and methods, students acquire extensive specialised skills. This qualifies them to work independently on problems, implement tasks and thus to create or further develop innovative products. A 12 week internship in industry serves to improve practical and social competencies.

Admission Requirements
Bachelor’s degree, particularly in the fields of automotive and engine technology and mechanical engineering, or equivalent university or university of applied sciences degree in an engineering subject, with above average grades.

Career Prospects
The vehicle and motor industry is a significant sector of our economy. Local and long-distance transport of goods and in particular individual mobility have become key elements in our daily lives. Over half of the academics employed in the private sector are engineers. The master’s degree in automotive and engine technology qualifies students to analyse and solve industrial issues and in particular to conduct research. Potential fields of employment apart from the major market of manufacturers of vehicles and their components are also, depending on the chosen specialisation, developers of drive and control engineering, and of mechatronic systems. In addition, engineering firms are an option, serving a wide variety of areas such as construction, development, consultancy, and project management. The master’s degree is also an admission requirement for a doctorate.

Further Information
www.ivk.uni-stuttgart.de

To see the complete range of almost 120 degree courses at the University of Stuttgart visit:
www.uni-stuttgart.de/studieren/angebot/studiengebiet.html
5. TOP-LEVEL RESEARCH AT TU9 UNIVERSITIES

Excellent Research for Sustainable Use of Energy

Against a background of climate change and an increasing scarcity of raw materials, sustainability must be a guiding principle of teaching, research and development. The TU9 Universities already offer a wide variety of degree courses in the areas of sustainable hydraulic engineering and power engineering. In traditional areas of engineering, sustainability and efficiency of resources are also playing an increasingly important role.

The TU9 Universities are conducting research into the great questions of today: How can we protect ourselves from the effects of climate change? How can we optimise the way we use and produce energy? And how is it possible to do this in a sustainable way?

As technical universities, the TU9 members are under a particular obligation to conduct energy research in such a way that future generations are not disadvantaged by our current use of energy. With their many research projects into efficient and resource-saving forms of energy supply and storage, the TU9 Universities are making a significant contribution to the transformation of the energy system. This research performance has made them into important scientific players for Germany’s high-tech industries.

The Indo-German Centre for Sustainability (IGCS) was opened at IIT Madras (IITM), in Chennai, India at the end of 2010. Other universities involved in the project alongside IITM are the TU9 Universities RWTH Aachen University, TU Berlin, TU München and the University of Stuttgart, as well as Christian-Albrechts Universität Kiel (CAU). RWTH Aachen is the coordinator for Germany. Research at IGCS focuses on four areas: water management, waste management, land use/rural development, and energy. Interdisciplinary research and Indo-German academic exchange are two of the key features of IGCS.

The centre concentrates not only on research but also on the education of undergraduates, doctoral candidates and scientists, and also serves as a hub for further networking on the topic of sustainability. So far some 100 young scientists from both countries have taken advantage of summer and winter schools, symposia and research visits to establish new contacts. Local and global expertise is treated equally. An excellent example of cooperation between industry and science is reflected in the IGCS Research School for Sustainable Power Engineering at IITM sponsored by Maschinenfabrik Reinhausen.

www.igcs-chennai.org.

Quality Engineering for Sustainability

Together with the German UNESCO commission, VDI and German companies, TU9 is a founding partner in the German contribution to the UNESCO Engineering Initiative “Quality Engineering for Sustainability”. Industrial partners are five prominent German companies: Bayer AG, Robert Bosch GmbH, E.ON SE, TÜV Rheinland AG and Volkswagen AG.

In November 2011 the UNESCO General Conference passed a resolution proposed by Germany on the “UNESCO Engineering Initiative”. The initiative focuses on emerging and developing countries. Its aims are:

- To modernise engineering education worldwide
- To incorporate sustainability topics
- To attract more women to engineering
- To improve the employability of graduates

Cooperation between German industry, TU9 and universities in the seven target countries Argentina, Brazil, China, India, Mexico, Thailand and Vietnam are to be intensified by the partnership. Students in particular benefit from the initiative: Students of engineering at the target universities will be given the opportunity to conduct internships and projects for their dissertations in the partner companies in the target countries and also in Germany.

www.quality-engineering.org
TAILORED FUELS FROM BIOMASS – A CLUSTER OF EXCELLENCE AT RWTH AACHEN

The Cluster of Excellence “Tailor-Made Fuels from Biomass” adopts an interdisciplinary approach, involving such fields as chemocatalysis and biocatalysis, process technology, combustion research and engine development. This approach is the key to a holistic and sustainable solution for future vehicular traffic.

Through the application of optimised synthesis processes to investigate new, biomass-based synthetic fuels, dependence on fossil fuels is to be minimised in order to strengthen the potential of modern combustion technologies. The long-term goal is to determine the optimal combination of fuel components and their production processes based on renewable raw materials and new combustion processes.

The Cluster of Excellence seeks innovative solutions for the customised conversion of the major components of plant material into value-added products. For further information visit: www.fuelcenter.rwth-aachen.de

GREENEST – INNOVATIVE COMBUSTION RESEARCH AT TU BERLIN

Scientists at TU Berlin are taking a completely new approach in developing a process to adapt combustion in gas turbines to the requirements of modern energy policies. In the project GREENEST – Gas turbine combustion with Reduced Emissions Employing extreme SToM injection – gas turbine technology is to be developed so that limited natural resources are used much more sparingly and hydrogen-rich fuels from biological resources can be exploited. The focus is on the process of ultra-wet combustion, where the hot exhaust gases of the turbine are used to add large quantities of steam to the combustion process. This not only leads to a significant increase in efficiency, but also greatly minimises the pollutant emissions that are created.

The project, which is attached to the TU Chair of Fluid Dynamics, is supported by the European Research Council with a prestigious Advanced Grant. GREENEST and further combustion research projects are being tested at the Energy Laboratory of TU Berlin, which was inaugurated at the beginning of 2014. The Energy Laboratory houses state-of-the-art test benches and creates space for innovation in the field of combustion research.

TU BRAUNSCHWEIG: FLEETS GO GREEN

The potential of electro-mobility for reducing the harmful environmental effects of road traffic under everyday conditions can be analysed and evaluated only through field trials. The aim of the project “Fleets Go Green” is therefore the holistic analysis and evaluation of the environmental efficiency of electro- and plug-in-hybrid vehicles under everyday conditions e.g. in fleet operations.

For the project, fleets of different electro vehicles were acquired, equipped with measurement technology to ascertain the total energy requirements, and put into service. The ecological and economic effects were demonstrated through a large-scale fleet trial and with the help of component and vehicle system simulations. This was made possible by the interdisciplinary cooperation of the participating companies (BS|Energy, imec Meßsysteme GmbH, I+ME ACTIA GmbH, iPoint-systems GmbH, Lautlos durch Deutschland GmbH, TLK-Thermo GmbH, Volkswagen AG) and research institutions (TU Braunschweig/Automotive Research Centre Niedersachsen, Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM).

For further information visit: www.fleets-go-green.de
TU DARMSTADT: ENERGY-EFFICIENT MODEL FACTORY OF THE FUTURE

In a real-life model factory on the TU Darmstadt campus, interdisciplinary research is being conducted into how energy efficiency can be drastically improved in industrial manufacturing. The approach: Everything from machines and building services to the building shell is designed to optimise energy consumption and to reduce energy requirements. Particular attention is paid to the exploitation of waste heat produced when operating the machinery. Through thermal storage and energy transformation technology, this energy can be stored and released when and where it is required.

The ETA-Fabrik (ETA Factory) project under the aegis of the Institute of Production Management, Technology and Machine Tools (PTW) at TU Darmstadt is supported by the Federal Ministry of Economics and Technology, the State of Hessen and some 30 industrial partners. TU Darmstadt combines the knowledge and expertise of mechanical engineers, production engineers, architects, civil engineers and designers of technical building services. Together, they ensure that energy-saving potential is investigated from different angles in a typical metalworking production plant. The ETA Factory is equipped with a range of real-life component-producing machinery from machine tools and cleaning machines to a furnace for heat treatment. Heat produced during heat treatment that typically goes to waste will cover the heating requirements of the cleaning machinery or, via an absorption refrigerating system, the cooling requirements of the machine tools. Furthermore, the waste heat provides appropriate air-conditioning in the factory. The ETA Factory thus fulfils three tasks in one: research, interdisciplinary training of young engineers, and in-service training of experts in industry.

www.eta-fabrik.de

TU DRESDEN: CARBON CONCRETE COMPOSITE – A BUILDING REVOLUTION

72 prominent firms and representatives of German universities have joined forces in the association “C3 – Carbon Concrete Composite” to pave the way for a building revolution. A total of eight institutes at TU Dresden are involved in the research and development of the new material carbon concrete composite. Professor Manfred Curbach of the Institute for Solid Construction is the initiator and president of the new association. The Federal Government supports the ambitious target of replacing at least 20 percent of steel reinforcement by carbon reinforcement to the tune of € 45 m. By using carbon concrete composite we can reduce energy consumption and CO₂ emissions during the construction and maintenance of our buildings and conserve valuable resources. The project received the GreenTec Award 2014 in the category Construction and Housing.

www.massivbau.tu-dresden.de

LEIBNIZ UNIVERSITÄT HANNOVER: OPERATIONAL OPTIMISATION FOR SHOPPING CENTRES OF THE FUTURE

Scientists at Leibniz Universität Hannover are investigating sustainable energy concepts for major shopping centres. In a joint research project (EffShop) supported by the Federal Ministry of Economics and Technology, a team from the Institute of Design and Building Construction (IEK) at the Faculty of Architecture and Landscape Sciences is conducting research into the operational optimisation of shopping centres. The partner is the E.ON Energy Research Center RWTH Aachen. Due to the growing number of shopping centres, it is important to develop sustainable energy concepts for this type of building. The first step is to analyse consumption and supply structures of two existing shopping centres and to determine potential energy saving. The subproject in Hannover focuses on energy/operational monitoring and the use of environmental energy such as near-surface geothermal energy.
LIGHTING WITHOUT HARMFUL SUBSTANCES – KARLSRUHE RESEARCHERS DEVELOP A MERCURY-FREE ENERGY-SAVING LAMP

Ever since they were introduced, energy-saving lamps have not been free from criticism: for some they are seen as essential in the fight against climate change, for others they are a lighting catastrophe. And opponents and supporters alike are annoyed that they last nowhere near as long as promised by industry and that they contain poisonous substances. So far, each energy-saving lamp has contained two milligrams of the nerve poison mercury. If it breaks, then poisonous vapours escape. Researchers at Karlsruhe Institute of Technology have now developed a mercury-free energy-saving lamp and have already presented it at Hannover Industrial Fair. The new technology from Karlsruhe could mean the final breakthrough for energy-saving lamps.

TU MÜNCHEN: SHAFT POWER PLANT – THE HYDROELECTRIC POWER PLANT NEXT DOOR

It is the oldest and “cleanest” renewable energy source. Yet the potential for hydroelectricity in Germany had seemed to be exhausted, and major projects in developing countries were coming under criticism for the major environmental impact. Researchers at Technische Universität München have now developed a small-scale hydroelectric plant that solves several problems at once: it is so simply constructed and thus so cost-effective that it is viable even with low flow rates – as for example at the many weirs that already exist in smaller rivers. Furthermore, since it is hidden in a shaft in the river bed, neither the landscape nor the waterway is affected. Fish can swim over the shaft. The power plants can generate power worldwide at thousands of unused sites in Europe and in regions which are so far without electric power.

UNIVERSITY OF STUTTGART: TOP-LEVEL RESEARCH INTO SUSTAINABLE ENERGY USE AND ELECTRO-MOBILITY

Scientists at the Institute for Energy Conversion (IEW) at the University of Stuttgart are focusing on the topic of e-mobility. They are investigating the development of highly efficient motors and generators as well as cable-free inductive power transmission systems. Fundamental research concentrates on the modelling and optimisation of energy converters. The results of this work flow into innovative and practice-oriented developments such as inductive charging systems and wheel hub drives for electro vehicles, and energy optimised robust drive systems for wind energy systems and industrial automation.

Sustainable solutions are at the heart of many other research areas at the University of Stuttgart, for example lightweight construction both in architecture and in aircraft and vehicle construction, and the development of efficient energy storage systems. Degree courses such as the bachelor's degree in renewable energy and the international master's degree "Integrated Urbanism and Sustainable Design" illustrate how this topic is established across the board in research and teaching.
Excellent Research for the Mobility of the Future

One of the greatest challenges of our time is how we should deal with dwindling reserves of raw materials: How can we guarantee individual and at the same time resource-efficient forms of mobility? Europe has set itself the ambitious target of reducing fossil fuel consumption by 80 percent by the year 2050. For the transport sector this means a rapid conversion to electro-mobility. The German Federal Government is committed to turning Germany into the leading market and leading producer for electro-mobility. This target requires close cooperation between research, science, industry and politics. Together with several different companies, the TU9 Universities are investigating new concepts of electro-mobility. They focus not only on developing improved storage technologies but also on adapting vehicle design at all levels.

SINO-GERMAN NETWORK ON ELECTRO-MOBILITY

In 2012, a research network on electro-mobility was established by TU9 and four major Chinese partner universities. TU München, Karlsruhe Institute of Technology and TU Berlin, together with the Chinese Partners Tongji University (Shanghai), Tsinghua University (Beijing), Huazhong University of Science and Technology (HUST, Wuhan), and Beijing Institute of Technology (BIT), are working on new technologies for electric cars in a variety of projects. The Germans and Chinese pursue the common goal of turning electro-mobility into a key technology for sustainable mobility concepts. The potential for cooperation is great. While the German car industry is a market leader in China, the Chinese have become pioneers in the production of batteries.

The cooperation is divided into individual projects from the areas of energy conversion and storage, concepts of electro vehicles, and energy supply and infrastructure. In close interdisciplinary cooperation, the projects aim to make innovative developments in electro-mobility. The topic of electro-mobility is to be systematically investigated and established for the long term in society.

For further information visit: www.sinogermanemobility.de

RWTH AACHEN: INNOVATIVE VEHICLE DESIGN SPEED E

SpeedE marks the third generation of electro vehicles developed at the Institute for Vehicle Technology (Institut für Kraftfahrzeuge (ika)), RWTH Aachen University. The core idea of this vehicle concept is to consistently implement the advantages of elective drive systems concerning their performance, controllability, acoustics and power density in the form of perceivable functions and a convincing design. At the same time it serves as a research and validation platform for innovative technologies in the vehicles of tomorrow, which are used for public projects and also bilateral research partnerships. The SpeedE concept includes innovations from the Steer–by–Wire steering with a 90° turning angle, contactless charging through the functional integration of drive and chassis, and the revolutionary design of exterior and interior. As well as efficiency and safety, the driving experience was given priority.
TU BERLIN: SMART E-USERS – CONCEPT FOR ELECTRIC CITY LOGISTICS

TU Berlin is currently participating in a major showcase project, together with Deutsche Post DHL, Dekra e. V., VIOM GmbH, DLR and others, to test concepts for e-mobility in commercial city traffic. The following facilities at TU Berlin are involved: the Distributed Artificial Intelligence Laboratory (DAI), the Logistics Section as the consortium leader, and the Department of Integrated Transport Planning.

The idea behind the project is to develop a concept for electric city logistics, providing for the complete integration of e-vehicles into commercial goods and passenger transport. In a pilot project starting in April 2014 this is being tested in Berlin city traffic with 20 e-vehicles belonging to Deutsche Post DHL. The aim is to optimise route planning essential to commercial traffic and to extend the charge control. This will happen by feeding in current traffic, weather and order data. The Smart E-User project is one of around 30 core projects in the showcase electro-mobility Berlin-Brandenburg.

www.e-mobility.tu-berlin.de

TU DRESDEN: INECO® - ULTRA-LIGHTWEIGHT ELECTRIC CAR WEIGHING ONLY 900 KILOGRAMS

Inspired by political and scientific debates on the topic of electro-mobility, members of the InEco®-Research Project sought an innovative, forward-looking and sustainable approach. The result is an ultra-lightweight electric car, which was developed by scientists from TU Dresden in cooperation with experts from the Leichtbau-Zentrum Sachsen GmbH (LzS) and ThyssenKrupp AG. To illustrate what the electric car of the future could look like, members of the InEco®-Project implemented their innovative vehicle design by constructing a four-seater demonstrator car for urban use. With a total weight of only 900 kilograms – with all components including the battery – the research car combines sporty driving pleasure and environmentally-friendly energy use, and cost-attractive construction design with an elegant appearance.

Photo: TU Dresden/ILK/LZS

TU DARMSTADT: WELL2WHEEL – INTEGRATION OF ELECTRO-MOBILITY INTO THE DISTRIBUTION GRID

The project Well2Wheel was launched in May 2013 with high-profile partners from science and industry (HEAG Südhessische Energie AG, NTB Technoservice, Continental Automotive GmbH, EUS GmbH, TU Darmstadt, FH Frankfurt, Fraunhofer Institute for Structural Durability and System Reliability (LBF). The aim of the project is to integrate electro-mobility as an active component into the grid and to steer it beyond the limitations of a network operator. Apart from the technical integration of electro-mobility into the grid, the main focus is on customer acceptance and user-friendliness. The Department of Electrical Power Supply with Use of Renewable Energies (E5) at TU Darmstadt (Chair: Prof. Dr.-Ing. Jutta Hanson) is focussing on energy research with reference to finding electro-mobility solutions for current challenges in the power supply. Here the emphasis is on the development of information and communication technologies and intelligent charge control. Grid simulations are conducted and charge strategies developed – over the whole energy supply chain.

www.well2wheel.de

TU BRAUNSCHWEIG: BEREIT – AFFORDABLE ELECTRICAL RANGE BY MODULARITY

In the project BEREIT, scientists at the Automotive Research Centre Niedersachsen (NFF) from TU Braunschweig and Leibniz Universität Hannover in cooperation with TU Darmstadt and leading companies in the automobile industry are conducting research into the development of modular plug-in hybrid vehicles that will be affordable to most people. Safeguarding mobility for the future means developing energy-efficient vehicles with new drive concepts. Electric drive systems in general and plug-in hybrid vehicles in particular help to reduce our dependency on fossil fuels, but are currently significantly more expensive than traditional internal combustion engines. In this project, which is in cooperation with Daimler, Bosch and ZF Friedrichshafen AG, scalable drive concepts for hybrid vehicles are being developed and two demonstration vehicles built using currently available components.

Various operation strategies for different drive concepts are being developed, taking different driving cycles into consideration. Next, a modular system of electrical machines and associated power electronics will be developed and optimised for vehicles with different degrees of electrification. A cost model with material and production costs according to the quantity produced will be devised to provide an estimate of possible cost savings due to the modular system.

www.e-mobility.tu-berlin.de
LEIBNIZ UNIVERSITÄT HANNOVER: THE WHEEL HUB ENGINE – INNOVATIVE DRIVE SYSTEM FOR ELECTRIC VEHICLES

A completely new vehicle concept is currently being developed at the Institute of Drive Systems and Power Electronics (IAL), Leibniz Universität Hannover. The transition from combustion engines to electric motors allows for cutting-edge innovative design. For reasons of space and performance, it makes sense to drive each wheel with a separate electric motor.

Funded by the Federal Ministry for Education and Research, a joint project with the Fraunhofer Gesellschaft, Leibniz Universität Hannover and the Automotive Research Centre Niedersachsen (NFF) is devoted to research into innovative wheel hub engines. Eliminating the traditional power train with drive, differential, and drive shaft means that less space is needed, and mass and friction are reduced. Parts subject to wear, and also maintenance of the vehicle can be reduced significantly.

KARLSRUHE INSTITUTE OF TECHNOLOGY: STORAGE TECHNOLOGIES IN COMPETENCE E

Since 1st January 2011 Karlsruhe Institute of Technology (KIT) has concentrated all work on electric energy storage for mobile and stationary applications in the project “Competence E”. This internationally unique concentration of 26 institutes from the fields of chemistry, materials research, production and process engineering, electrical engineering, product development, vehicle systems, information technology, and technology assessment on the entire system electric energy storage makes it possible to develop industrially applicable and cost-effective solutions for stationary storage systems and electric drive trains for future generations. Here an integrated approach is taken from the molecule to the battery, and the electric motor with power electronics to the entire working electric power train.

Parallel to the development and prototype construction of new kinds of cells, batteries and power trains, new processes for the cost-effective production of these batteries and e-drive systems are being developed and demonstrated. For this, the first freely accessible research factory, the “System Engineering Center” was set up at KIT to close existing gaps in the innovation and value-added chain.

The target is to develop battery systems for use in vehicles and stationary applications within seven years, which feature a gravimetric density of 250 Wh/kg and are producible on an industrial scale at the cost of €250 per kWh.
TU MÜNCHEN: EVA – ELECTRIC TAXIS FOR TROPICAL MEGACITIES

TUM was the first university in the world to develop two electric cars for different climate zones. After presenting the MUTE at the Frankfurt International Motor Show IAA in 2011, an electric car for European regional transport, it exhibited the electric taxi EVA for tropical megacities at the Tokyo Motor Show in 2013.

Taxis play an important role in the overcrowded megacities, with individual vehicles often in operation 24 hours a day. The researchers therefore developed a rapid charging system which recharges the battery in only 15 minutes – in other words during a typical driver’s break. This was made possible by highly effective cooling of the batteries during charging.

A further challenge in tropical regions is the high demand made on the air-conditioning of the vehicle. EVA offers a system where each passenger can regulate their own air-conditioning with minimum energy consumption. The electric car has a range of 200 kilometres. EVA is a project of TUM CREATE, a joint research programme of TUM subsidiary TUM Asia and Nanyang Technological University (NTU), situated on the CREATE campus in Singapore.

UNIVERSITY OF STUTTGART: ARENA 2036 – PARTNERSHIP FOR INNOVATIONS

The research campus ARENA2036 (Active Research Environment for the Next Generation of Automobiles) at the University of Stuttgart has brought scientists from research institutes and industry together to benefit from synergies in the fields of production and lightweight construction. They are conducting fundamental research and developing competitive production models for the flexible car factory of 2036, the 150th anniversary of the automobile. Lightweight materials such as fibre composites will then be as manageable in serial production as steel and aluminium are today. Moreover, flexible production will replace the rigid production line and there will be new kinds of cooperation between people and robots.

The project sees customer wishes for individual vehicles with a high degree of comfort and enhanced safety as an impulse to develop concepts of intelligent lightweight construction and flexible production. The objectives of the project are affordable diversity for all, and lighter vehicles with enhanced comfort.

Apart from the University of Stuttgart, further partners of ARENA2036 are: German Institutes for Textile and Fibre Research Denkendorf (DITF), the German Aerospace Centre (DLR), Fraunhofer-Gesellschaft (FhG), BASF SE, Daimler AG, Robert Bosch GmbH and as a partner in the initial projects KMU Artur Bär Maschinenbau GmbH and DYNAmore GmbH.
With the establishment of the Center for Computational Engineering Science in 2002 and the introduction of the ‘Computational Engineering Science’ (CES) degree course, RWTH Aachen has provided the basis for research and education in this cutting-edge field. In November 2006, these steps were complemented by the founding of the AICES Graduate School. The re-evaluation of AICES in 2012 certified the excellent work and concept of the graduate school. AICES is spearheaded by more than 25 RWTH institutes from eight departments and includes participation from the Forschungszentrum Jülich and the Max Planck Institute for Iron Research in Düsseldorf. Approximately 50 doctoral candidates from the partner institutes as well as 40 AICES doctoral candidates and master’s students are involved in the research and training programme. To name just one aspect of the school, the improved advisor-candidate ratio ensures intensive training and academic advising, which contributes to reducing time to degree completion while ensuring the high quality of graduate education.

Because of the steadily increasing potential of computers and computer networks in both natural and engineering sciences, AICES focuses on the importance of modeling and computer simulation. AICES is training a new generation of doctoral candidates who are acquiring profound knowledge in engineering science, applied mathematics and computer science. Because of its interdisciplinary focus and method-oriented approach, AICES is able to cope with the rapid development of the discipline of scientific computing in engineering and natural sciences. In the future, this field of research will have a significant impact on the development of technology, addressing socio-economic requirements in terms of innovative scientific and industrial research and development processes. Therefore the AICES Graduate School focuses on the unique and sophisticated aspects of computational analysis and computer-based design.

Further information: [www.aices.rwth-aachen.de](http://www.aices.rwth-aachen.de)
TU Berlin: Berlin International Graduate School of Natural Sciences and Engineering (BIG-NSE)

The Graduate School “Berlin International School of Natural Sciences and Engineering” (BIG–NSE) is part of the Cluster of Excellence “Unifying Concepts in Catalysis” (UniCat). Members are the three major Berlin universities and further scientific institutions in Berlin and Potsdam. The goal of the Graduate School is to support highly qualified young scientists. They should complete their doctorates at a high scientific level in the shortest possible time, i.e. in a maximum of three years. To this end, the chosen doctoral candidates take part in a structured programme with excellent supervision.

This begins with a joint three-month block, where the doctoral candidates prepare for their thesis topics and also become familiar with the different subject areas of the cluster UniCat. The main focus here is on interdisciplinary collaboration in the different fields of activity. In addition, each doctoral candidate is assigned a mentor from a higher year. As well as receiving financial support, the doctoral candidates attend regular lectures held by internationally established scientists. In addition, they take part in language and soft skills courses.

This support in complex areas of natural and engineering sciences leads to a doctoral thesis, and at the same time social and personal networks and a “common language” are cultivated among the doctoral candidates.

Further information: www.big-nse.tu-berlin.de
E-Mail: office@big-nse.tu-berlin.de
The Braunschweig International Graduate School of Metrology (B-IGSM) is a joint facility of Technische Universität Braunschweig and the Physikalisch-Technische Bundesanstalt (PTB), functioning as an international research and educational centre for the science and applications of metrology in the areas of electrical engineering and information technology, physics, mechanical engineering and life sciences. B-IGSM is a cornerstone of the Metrology Initiative Braunschweig, a further member of which is the Research Institute for Nano-Metrology.

Metrology, as an interdisciplinary field, ranges from fundamental research on quantum- and nanometrology, to metrology in life science to practice-oriented areas of industrial metrology, like for example metrology of production and instrumentation. Topics chosen for study depend on individual curricula.

Metrology aims at international harmonisation, and for this reason the B-IGSM has a pronounced international approach. The strong metrology-related research focus of TU Braunschweig and PTB, Europe’s largest and one of the internationally leading national metrology institute, make Braunschweig an excellent location for such a Graduate School. The research areas of the Graduate School are open to students from all scientific areas linked to the field of metrology. Graduates with a master’s degree or an equivalent degree in engineering and natural sciences are admitted at B-IGSM.

Studying successfully at the Braunschweig International Graduate School of Metrology will qualify graduates both for an academic and for an industrial career. Students will receive an individually drawn up curriculum and be given the chance to establish many contacts with industry and research institutions.

Further information: igs.tu-bs.de
E-Mail: igs@tu-braunschweig.de
The Graduate School of Computational Engineering at TU Darmstadt focuses on computer based modelling, simulation, analysis and optimisation. Computational Engineering (CE), an interdisciplinary combination of mathematics, computer science and engineering sciences, has established itself as an independent scientific approach. Thanks to the constant improvement of the methods and the availability of a high performance computing environment within recent years, CE will play an important role in finding solutions for complex engineering problems in the future. The Graduate School focuses on the following key research areas:

- Modeling and simulation of coupled multi-physical problems
- Simulation based optimisation
- Hierarchical multi-scale modeling and simulation

Individual projects deal with the simulation of combustion processes in aircraft turbines or with the improvement of the efficiency of wind energy plants. Another area is for example the minimisation of the exposure to radiation of mobile phones while taking the improvement of the quality of reception and language into consideration.

To ensure high standards and an efficient education, which also includes non-technical aspects, the Graduate School enjoys the following features:

- Interdisciplinary approach
- International and intercultural exchange
- Integrated training of complementary skills
- Fast-Track-Option for CE master’s students
- Financial support of all accepted students
- Close cooperation with partners from science and industry
- High performance computing environment available

The interdisciplinary PhD-programme in computational engineering builds on the bachelor’s and master’s degree courses in this field. The Graduate School CE thus rounds off the existing initiatives in the research field of Computational Engineering at TU Darmstadt and plays a key role in both research and teaching.

Further information: www.graduate-school-ce.de
The ‘Dresden International Graduate School for Biomedicine and Bioengineering’ (DIGS-BB) was recognised by the German Excellence Initiative as one of the top institutions for graduate training. It is among the largest and most prestigious international graduate study programmes in Germany. Excellent international graduates in the fields of natural science, medicine and engineering are selected in a highly competitive selection procedure for one of three PhD programmes:

▪ Molecular Cell, Developmental and Systems Biology (CellDevoSys Programme)
▪ Regenerative Medicine (RegMed Programme)
▪ Molecular Bioengineering and Biophysics (BioEng Programme)

In joint collaboration with the “International Max Planck Research School for Cell, Developmental and Systems Biology” (IMPRS-CellDevoSys), the Graduate School provides advanced training and offers opportunities to conduct top-level experimental research in one of the 80 participating groups on the Dresden Campus.

Currently, about 200 PhD students are working towards their doctorate, which is conferred by one of the Faculties of Science, Medicine, Engineering, or Computer Science. The Thesis Advisory Committee (TAC) composed of three group leaders serves as tutors to support and guide the PhD students throughout the three to four years of thesis work. Most importantly, graduate students benefit from the enormous scientific expertise of the participating scientists and the excellent facilities at the participating research institutions in Dresden. Graduate students are encouraged to participate in joint interdisciplinary research projects.

Further information: www.digs-bb.de

International PhD students conduct research at DIGS-BB.
Leibniz Universität Hannover: Research Training Group ‘Analysis, Geometry and String Theory’

In March 2013, the Research Training Group ‘Analysis, Geometry and String Theory’ funded by the German Research Foundation (DFG) started its second round of funding. Since the foundation of this doctoral programme, it has significantly helped to raise the university’s profile as an international centre for mathematics and physics research. The Research Training Group aims to provide young scientists with an attractive environment to carry out research on current projects in mathematics and theoretical physics.

For this reason, apart from several institutes at the faculty ranging from pure mathematics to theoretical physics, a number of leading international partners are involved. These joint projects are set to expand through further national and international cooperation agreements. In particular, they serve to attract excellent students of mathematics or physics to Leibniz Universität Hannover.

International experts in analysis, geometry and string theory hold lectures, workshops and seminars at the Research Training School. This allows for the doctoral candidates to take part in scientific exchange beyond the boundaries of the university.

The postgraduate students gain a thorough and interdisciplinary understanding of all three research areas of the group. Subsequently, two of these areas are analysed in more depth. In the next few years, more than 20 international scientists and PhD students will carry out research into the many and varied relationships between main areas of mathematics and theoretical physics.

Further information: [www.grk1463.uni-hannover.de](http://www.grk1463.uni-hannover.de)
The PhD programme of the graduate school Karlsruhe School for Elementary Particle and Astroparticle Physics: Science and Technology (KSETA) is unique in the world. Here, young doctoral students are given the opportunity to work in international large-scale projects in the area of elementary particle and astroparticle physics and to optimally prepare for a career in science or industry. KSETA is of a highly interdisciplinary character and brings together scientists and doctoral students of four departments of the Karlsruhe Institute of Technology (KIT). Studies at KSETA focus on theoretical and experimental aspects of elementary particle and astroparticle physics as well as on technologies of large-scale international projects. Excellent support and supervision of doctoral students in the research areas of relevance to KSETA is ensured by professors and experienced scientists and post-docs. Moreover, KSETA cooperates closely with the Karlsruhe House of Young Scientists (KHYS) and the Young Investigator Network (YIN). The School offers an international and multi-cultural work environment resulting among others from participation in a number of international large-scale projects (e.g. Auger, EDELWEISS, KASCADE, and KATRIN) and a large number of foreign scientists working at the KIT Center KCETA. All in all, KSETA offers a diverse programme, consisting of lectures, block seminars, workshops, and external training courses to complete education on site. The programme follows the motto DEEPER, BROADER, BETTER:

- **Deeper** means conveying the expert knowledge necessary to participate in current research projects as quickly as possible. Due to the worldwide leading role of KCETA in the area of elementary particle and astroparticle physics, the depth of the offers is unique.
- **Broader** means the acquisition of a broad spectrum of knowledge beyond the area of specialization of the PhD students.
- **Better** means the acquisition of key competences and soft skills. The scope of courses includes social competences, language, presentation, and management courses as well as cultural offers.

Further information: [www.kseta.kit.edu](http://www.kseta.kit.edu)
Interdisciplinary project teams with research topics at the interface of science, engineering and medicine are at the core of the TUM International Graduate School of Science and Engineering (IGSSE).

Doctoral candidates learn to explore new avenues in research through crossing the borders of their scientific fields. At the same time they benefit from an outstanding qualifications programme that combines the academic excellence of the TU München with tailor-made professional and personal training. In addition to the multidisciplinary exchange, doctoral candidates complete an international research phase of several months, develop their entrepreneurial know-how and extend their interpersonal skills.

Postdocs who lead the IGSSE project teams are given access to specialised training and support.

The IGSSE provides outstanding master’s students with the opportunity to gain their first research experience in an interdisciplinary setting.

As a result of its innovative concept and internationally recognised success, the IGSSE was a winner in the highly competitive Excellence Initiative in 2006 and 2012 and has received over €15 million in funding. In the second period of funding it established focus areas which integrate thematically related work groups. These networks are used by the TU München as incubators for research fields of emerging importance.

In 2009 the IGSSE formed the template for the foundation of the TUM Graduate School, which has established high-quality international standards within doctoral studies throughout the university.

Further information: www.igsse.tum.de
Factory of the next generation – a new paradigm of industrial production

As an internationally leading centre for the training of highly qualified young scientists through top-level research and innovation in the field of advanced manufacturing engineering, the Graduate School of Excellence at the University of Stuttgart provides an excellent environment for doctoral research. The dual system combines innovative research and an excellent academic education, technology and management, theory and practice for the first time in a structured doctoral programme. This has proved successful in training the next generation of academics and managers from the fields of engineering, computer science and business administration to face the challenges of the global job market. The GSaME has a status similar to that of a faculty, with the right to confer the doctorates of Dr.-Ing. and Dr. rer. pol.

At the centre of the research and training programme of GSaME is a comprehensive system with technical, methodological, and organisational solutions and tools for a new paradigm of sustainable industrial production. Doctoral students are integrated into one of the strongest centres for production research worldwide, with outstanding conditions for pure and applied research.

As well as conducting original scientific research, students gain skills in methodology and in subject-specific and more general qualifications. Essentially, transparent and suitable supervision structures help them to reach their research and qualification goals within the designated 4 year period.

GSaME is interdisciplinary and international; it includes five faculties with more than 30 professors at the University of Stuttgart and cooperates closely in research and training with partners from science and industry. Partners include well-known companies, foundations, associations and the Fraunhofer Society.

GSaME received the Best Practice Award for improving doctorates in engineering from the German National Academy of Science and Engineering (acatech) for its innovative concept for developing key qualifications. It was again successful in the second round of the Excellence Initiative to strengthen top-level university research.

Further information: www.gsame.uni-stuttgart.de
Since November 2006, more than 25 professors and institutes at RWTH Aachen have been working within the Cluster of Excellence “Integrative Production Technology for High-Wage Countries” to find common solutions for maintaining sustainable and competitive production in Europe.

As one of Europe’s key industries with more than 30 per cent of the workforce dependent on it, production represents a significant foundation of the European economy. It faces ever increasing pressure through globalisation. The Cluster of Excellence rises to this challenge with research projects across several institutes in the fields of mechanical engineering, materials science, information technology, mathematics, economics and psychology, cooperating closely with industry.

Together they focus on the fourth industrial revolution which is driven by the increasing involvement of information and communication technology. This change is made possible through intelligent production systems, from individual machine and control components for more dynamic and flexible production through consistent data and software solutions to the integrated self-optimising factory. The internal cluster research projects focus particularly on individualisation, virtualisation, integration and self-optimisation of production.

A platform developed in the Cluster of Excellence enables direct technology transfer between the university and industry. The cluster projects support firms in using their know-how effectively, developing it in an intelligent way and applying it successfully in the long term. The Cluster of Excellence thus makes a significant contribution to securing the key position of production and the accompanying jobs in highly-developed economies.

Further information: [www.production-research.de](http://www.production-research.de)  
E-Mail: xcluster@wzl.rwth-aachen.de
TU Berlin: Cluster of Excellence Unifying Concepts in Catalysis

In the Cluster of Excellence “Unifying Concepts in Catalysis” (UniCat), Berlin and Potsdam pool their strengths in the field of catalysis. Four universities and two Max Planck Institutes are involved. Currently, 38 working groups from the areas of chemistry, biology, physics and chemical engineering collaborate to conduct interdisciplinary research in catalysis, an extremely important area for the economy.

The Cluster of Excellence UniCat is unique in the international research landscape. In its focused research programme, the UniCat scientists set the course for bridging the gap between chemical and biological catalysis.

UniCat investigates new synergies between chemistry and biology on catalytic activation and the subsequent transformation of small molecules, which are of major significance not only for raw material change but also for the development of medicines.

Methane is the main component of natural and biogas. An ambitious goal is to produce ethylene to a high level of efficiency through oxidative coupling of methane. This raw material, which is of crucial importance in the chemical industry for the production of polymers and medicines, is currently mainly obtained from mineral oil.

Carbon dioxide is a problematic greenhouse gas. UniCat investigates how it can be exploited catalytically, for example to produce important chemical materials such as carbon monoxide and formic acid.

Furthermore, through the coupling of biocatalytic processes scientists are investigating the production of new antibiotics and diagnostic agents for medical applications.

In order to rapidly transform fundamental research into viable industrial processes, a mini-plant testing facility was commissioned in 2009. This work is also of interest to our cooperation partners from industry: at the end of 2011, a new joint laboratory known as BasCat was set up together with BASF SE to speed the transfer of research results into applications.

UniCat and its follow-on projects for integrated catalysis research in the Berlin area have found a permanent home in the Gerhard Ertl Center since 2012. Members of UniCat:

- Technische Universität Berlin (host university)
- Freie Universität Berlin
- Humboldt-Universität zu Berlin
- Universität Potsdam
- Fritz-Haber-Institut der Max-Planck-Gesellschaft
- Max-Planck-Institut für Kolloid- und Grenzflächenforschung in Potsdam

Industrial partners: BASF SE, Bayer HealthCare AG, Clariant Produkte (Deutschland) GmbH, Evonik Industries AG, Endress+Hauser Messtechnik GmbH+Co. KG, Siemens AG, ThyssenKrupp Industrial Solutions.

Further information: www.unicat-berlin.de
TU Braunschweig: The Automotive Research Centre Niedersachsen

Technische Universität Braunschweig concentrates its strengths in the strategic research area ‘Mobility and Traffic’ in the Automotive Research Centre Niedersachsen (NFF). The Centre is located at the Mobile Life Campus in Wolfsburg and at Braunschweig Research Airport. The foundation of the interdisciplinary ‘Automotive Research Centre Niedersachsen’ has established the research region Braunschweig as a centre for automotive research activities with an international reputation.

Vision Metropolitan Car
In 2007, the urban population of Germany exceeded the rural population for the first time. In the mid-term, approximately 80 percent of the world population are going to live in cities and the demographic trend towards an older society will accelerate this process. As a consequence, expanding metropolises are confronted with growing needs of individual mobility. Social, environmental and economic demands on sustainable automobile mobility in high density areas are a major challenge in future urban development. Thus, the Automotive Research Centre of Vehicle Engineering (NFF) as an institution of TU Braunschweig has developed the vision of the Metropolitan Car. It focuses on the development of prospective technologies and usage-models guaranteeing sustainable individual mobility in high density areas.

The uniqueness of this research concept results from the holistic consideration of user requirements in four defined target fields; these are: ‘The Intelligent Vehicle’, ‘The Low-Emission Vehicle’, ‘Flexible Vehicle Concepts’ and ‘Infrastructure, Society and Mobility Concepts’. These fields serve as a framework for setting focal points in project-oriented research and are handled by interdisciplinary teams.

Further information: www.nff.tu-bs.de
E-Mail: nff@tu-braunschweig.de
At the Cluster of Excellence ‘Smart Interfaces – Understanding and Designing Fluid Boundaries’ (short: Center of Smart Interfaces) of TU Darmstadt, scientists from the fields of engineering and the natural sciences conduct research on interfaces at which fluids (gas and/or liquid) interact with a solid surface. The term ‘Smart Interfaces’ refers to intelligent interfaces which are designed to influence mass, momentum or heat transfer.

To achieve this, 26 professors and leading scientists from the Departments of Chemistry, Physics, Mathematics, Materials and Earth Sciences and Mechanical Engineering of TU Darmstadt as well as non-university research institutes in Darmstadt and Mainz analyze for example:

- The spread of fluids on surfaces of solid bodies, which is important for many technical processes as for example printing. At present, such dynamics of wetting are only known for simple fluids on smooth, homogeneous surfaces and at isothermal conditions. The wetting of complex fluids such as dispersions and emulsions (paint, milk, blood, etc.) at non-isothermal conditions or on complex surfaces, however, is especially important for technical processes. Therefore, better understanding of these phenomena would improve many technical processes.

- The enhancement of heat transfer of surfaces by influencing their structure or wettability. Findings in this field would save energy and increase power density in many plants and devices. With an efficient cooling of surfaces it is for example possible to enhance the effectiveness of gas turbines, improve the efficiency of micro chips and reduce the energy consumption of cars.

These examples show the fields the research of the Center of Smart Interfaces addresses as well as its importance for mechanical engineering and other areas. The research into the influence of surface morphology not only helps to improve energy and transportation technology but also to enhance process and production engineering. A successful transfer of new technologies is guaranteed by the cooperation with industry partners.

Further information: [www.csi.tu-darmstadt.de](http://www.csi.tu-darmstadt.de)
The ‘Center for Advancing Electronics Dresden’ (cfaed) at Technische Universität Dresden is part of the German Excellence Initiative. The Cluster of Excellence for Microelectronics is being funded from 2012 to 2017 to the tune of €34 million by the German Research Foundation (DFG). The coordinator is Prof. Dr.-Ing. Gerhard Fettweis, Chair of Mobile Communication Systems. The research association comprises eleven partner institutes in Saxony. Further members are the Technische Universität Chemnitz, two Max Planck Institutes, two Fraunhofer Institutes, two Leibniz Institutes and the Helmholtz-Zentrum Dresden-Rossendorf. About 300 scientists from more than 20 different countries are working in nine research paths to investigate completely new technologies for electronic information processing. These technologies are inspired by innovative materials such as silicon nanowires, carbon nanotubes or polymers or based on completely new conceptions such as the chemical chip or circuit fabrication methods by self-assembling structures e.g. DNA-Origami. The orchestration of these new devices into heterogeneous information processing systems with focus on their resilience and energy-efficiency is also part of cfaed’s research programme. Furthermore, biological communication systems are analysed with the aim to use nature as an inspiration for technical challenges. The centre’s approach of uniting the natural sciences, which are driven by discovery, and engineering, which is based on innovation, in an interdisciplinary research platform is unique in Saxony and even worldwide.

Further information: www.cfaed.tu-dresden.de
Leibniz Universität Hannover: Leibniz Research School QUEST

Leibniz Research School QUEST (Centre for Quantum Engineering and Space-Time Research) combines the expertise of several institutes at Leibniz Universität Hannover with the competence of such renowned partner institutions as:

- the Max Planck Institute for Gravitational Physics (Albert Einstein Institute, AEI)
- the gravitational wave detector GEO600
- the Physikalisch-Technische Bundesanstalt (PTB)
- the Laser Zentrum Hannover e. V. (LZH)
- the Center of Applied Space Technology and Microgravity (ZARM)

Based on the outstanding expertise of all the QUEST partners in the core areas quantum engineering and space-time research, the QUEST scientists have set themselves ambitious goals. They want to make a significant contribution to addressing exciting and fundamental issues in modern physics by concentrating on the development of new research methods and technologies to an as yet unattained degree of precision.

Leibniz Research School QUEST originated in the Cluster of Excellence of the same name supported by the German federal and state governments. It was set up as the first of its type at Leibniz Universität Hannover and enjoys the same legal status as a faculty. The Research School runs its own degree programmes and builds on existing cooperation with external partners. New applications, fundamental physics, and applied areas such as earth observation, navigation and geodesy are the main focus. QUEST’s activities span four key areas of current research: quantum engineering, quantum sensors, space-time physics and new technology. All these activities will lead to new quantum standards beyond the limits of traditional physics, to unprecedented precision measurements of space and time, to innovative atomic clocks, to the beginnings of gravitational wave astronomy (GEO600 and LISA), to inertial quantum sensors, to innovative atomic gyroscopes and gravimeters as well as completely new approaches and equipment. This progress lays the foundations for fundamental tests on the links between space-time, gravitation and quantum physics. They also enable significantly increased precision in geodetic measuring and modelling and in investigating the complex dynamics of the earth system.

Further information: www.quest-lfs.uni-hannover.de
The Karlsruhe Institute of Technology (KIT) runs unique scientific infrastructure facilities so that researchers can cooperate on the highest level beyond the borders of their individual institutes or disciplines. The KIT Centers represent the largest organisational units. They serve the planning and development of research into fundamental problems and the transfer to the application stage. One example is the KIT Energy Center established on January 01, 2008. It pools the energy research activities of KIT and renowned cooperation partners. With about 1,250 employees and a total budget of € 250 million, the KIT Energy Center is one of the largest energy research establishments in Europe.

The activities of the KIT Energy Center combine expertise in engineering and science with know-how in economics, the humanities, social science, and law. They combine fundamental and applied research into all relevant types of energy for industry, households, services, and mobility. The scientists study all the processes from energy conversion to storage, and from distribution to the use of energy. They develop holistic energy concepts and study interactions with other areas of industry and society. Work at the KIT Energy Center is organised in seven areas:

- Energy conversion
- Renewable energies
- Energy storage and distribution
- Efficient energy use
- Fusion technology
- Nuclear energy and safety
- Energy systems analysis

The KIT Energy Center supports the transformation of the energy system in Germany towards a secure and sustainable supply. Consequently, its work concentrates on the strategic areas of energy systems, storage technologies, grids, energy efficiency, and renewable energies. Research conducted by the KIT Energy Center is internationally visible and embedded in cooperation projects with renowned partners in Germany, Europe, and the world.

Further information: [www.energy.kit.edu](http://www.energy.kit.edu)
How was the Universe formed? What are the fundamental forces and structures? Why are there galaxies, stars and planets? What led to the formation of chemical elements? What is the future hold for the cosmos?

These questions demonstrate the topics scientists have to deal with when studying the Universe. To this day, scientists have not yet found a satisfactory explanation of how the cosmic building blocks of matter, space, and time as well as the basic forces have developed. Also, the question is still open as to why the (nowadays generally accepted) standard model of physics cannot explain a number of phenomena of modern particle and astrophysics – the reason why physicists have designed theoretical models such as supersymmetry (SUSY) and string theory.

The Cluster of Excellence "Origin and Structure of the Universe" was established at the Technische Universität München (TUM) in October 2006 within the framework of the so called Excellence Initiative. In 2012, the funding of this unique and internationally recognised Research Center was renewed for another five years.

This interdisciplinary research project unites the physics faculties of TUM and Ludwig–Maximilians–Universität (LMU Munich). Other partners are the Universitätssternwarte (University Observatory) of the LMU, several Max Planck Institutes and the European Southern Observatory (ESO).

Further information: www.universe-cluster.de

**Further Clusters of Excellence with TUM participation:**
- Center for Integrated Protein Science Munich (CIPSM)
- Munich–Centre for Advanced Photonics (MAP)
- Munich Cluster for Systems Neurology (SyNergy)
- Nanosystems Initiative Munich (NIM)
The Cluster of Excellence in Simulation Technology (SimTech) focuses on the broad field of applications of simulation sciences, ranging from the production of new materials and products to environmental engineering and complex questions in the field of biomechanics. The main scientific emphasis lies on the following fields:

- Molecular and Particle Dynamics
- Advanced Mechanics of Multi-field and Multi-scale Problems
- Systems Analysis and Inverse Problems
- Numerical and Computational Mathematics
- Systems Analysis
- Integrated Data Management and Interactive Visualisation
- High-performance Computing
- Integrative Platform of Reflection

New developments in modelling and simulation technology have increased expectations in science and industry. Currently, there are individual strategies that only loosely link the participating disciplines. SimTech merges and enhances these concepts to a new class of an integrative simulation environment that covers all aspects ranging from a model to an interactive system. The latter also plays an important role in the fields of control engineering and automation. In the cluster, interactive systems are simulated in order to enhance them. This is done by using interactive and visualising user interfaces and a three-dimensional (3D) ‘Virtual Reality’.

By simulating complex interactions, the cluster provides new insights into the underlying processes and helps to improve simulation strategies in engineering and natural science. Thus, the cluster not only enhances modelling and simulation methods but also numerical mathematics for predictions, data management and visualisation methods with the overall goal of improving the performance and reliability of future simulation systems.

During the funding period, the cluster is embedded in the Stuttgart Research Centre for Simulation Technology (SRC SimTech). The scientific results of SimTech are used in several research areas as well as in teaching, and are refined such that they can be offered to industry by the Industrial Consortium Simulation Technology (IC SimTech). SimTech collaborates closely with visiting scientists, partners from industry, and nearby research centres. To guarantee scientific interdisciplinary cooperation, there are various symposia projected as well as a major SimTech conference. Finally, the Cluster of Excellence puts great emphasis on promoting young scientists through the Graduate School Simulation Technology (GS SimTech).

Further information: [www.simtech.uni-stuttgart.de](http://www.simtech.uni-stuttgart.de)
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